WORKING PLAN FOR THE SOUTH MANGALORE FOREST DIVISION, MADRAS

BY

P. W. DAVIS, B.A., I.F.S.,
Deputy Conservator of Forests

UNDER THE DIRECTION OF

C. C. WILSON, I.F.S.,
Conservator of Forests, Working Plans Circle

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INTRODUCTION.

A working plan for South Mangalore Division is long overdue. Since the first working plan for the forests of South Kanara was drawn up by Mr. Foulkes in 1901–02, there has been little attempt to co-ordinate the working of these forests. This plan was followed, with numerous deviations, until the year 1923, although it had been virtually obsolete from 1912 onwards. Several other working plans for small isolated tracts have been prepared from time to time, but with the exception of the working plan for Muliar reserve, drawn up by Mr. Raman Menon in 1915, all these were cancelled shortly afterwards, or for one reason or another, were not put into effective operation. Mr. Hart's working scheme for the extraction of timber from the reserves tapped by the river Paiswani and its tributaries was an ambitious attempt made with inadequate staff and under several difficulties to formulate a plan of management covering the reserves of the southern part of the division, but it was put into only very partial effect. Mr. Hart reported that the irregularity of the forests was such that a regular working plan for them was impracticable.

The decision in 1927 to install a sawmill in the division capable of dealing with about 90,000 cubic feet of logs per annum rendered a thorough survey and reconnaissance of the timber bearing forests of the division a matter of some urgency. The writer was accordingly deputed to carry out a reconnaissance in 1927–28. The report submitted in September 1928 was followed by orders to draw up a working plan for the division. Field work was started in October 1928, but for several months until the ensuing rains, a scarcity of staff for the purpose of stock-mapping and enumerations delayed progress. During this time, decisions affecting the future allocation of the sawmill then at Parappa which threatened an early exhaustion of the forests in that vicinity, had to be arrived at. In consultation with the Conservator of Forests, VI Circle, it was decided that the two best alternative sites, e.g., at Sampaje and Sunkadakatte localities, were not a practicable proposition. This decision was embodied in the letter of the Conservator of Forests, VI Circle, to the Chief Conservator of Forests, No. A-1167/29, dated 22nd September 1929. By November 1929, enumerations were begun with an enhanced staff made available after the abolition of the Logging Branch. Field work continued until May 1931.

The following served under the writer in the course of the preparation of the plan :—

Mr. M. H. Krishnaswamy	Extra Assistant Conservator.	1st May 1930 to 30th September 1930 and 27th November 1930 to 7th November 1931.
„ H. E. Brown	Do.	6th April 1930 to 24th July 1930 and 27th August 1930 to 30th November 1930.
„ K. Raghavan	Ranger	9th December 1929 to 10th January 1931 and 4th March 1931 to 17th March 1931.
„ T. Perumal Gowandan	Do.	6th November 1930 to 3rd February 1931.
„ J. D. Theodore	Do.	16th April 1929 to 31st July 1929 and 27th March 1930 to 8th November 1930.
„ I. Z. Robert Paul	Do.	4th October 1929 to 25th January 1931.
„ S. Nageswaran	Do.	4th January 1929 to 2nd July 1929 and 20th July 1929 to 7th November 1931.
„ K. Poovappa	Forester	10th October 1929 to 7th November 1931.
„ P. P. Kanna Poduval	Do.	24th September 1929 to 6th February 1930 and 2nd March 1930 to 1st May 1931.
„ S. A. Augustine	Do.	9th April 1930 to 16th February 1931.
„ M. B. Madappa	Do.	10th April 1930 to 3rd February 1931.

Messrs. M. H. Krishnaswamy, H. E. Brown, I. Z. Robert Paul, T. Perumal Gowandan and K. Poovappa assisted also in the preparation of the working plan for North Mangalore Division during the above periods. Ranger S. Nageswaran assisted the writer well throughout the period of field and office work and deserves special commendation.

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PART I

Summary of facts on which the proposals are based.

CHAPTER I.—THE TRACT DEALT WITH.

SECTION 1.—NAME AND SITUATION.

1. *General.*—The present working plan covers the forests of the South Mangalore Division.

2. *Position.*—The tract dealt with lies approximately within the limits 12° 29′ and 13° 10′ of north latitude and 74° 50′ and 75° 50′ of longitude east of Greenwich. The sea-board of South Kanara lies here at its broadest stretch of some 55 miles between the coast and the frontiers of Coorg and Mysore.

3. *Distribution of the forests.*—The great majority of Government forests are confined within a belt of country about 15 miles broad, shaped in a somewhat elongated arc centred on Mangalore, and as the crow flies distant from it on the average about 45 miles. These reserves cover the foothills and principal slopes of the Western Ghat range and occupy the upper catchment sections of the Netravati, Kumaradhari and Chandragiri river basins. The ghat range sweeps decisively coastwards in the northern and southern sections. In the coastal region, reserves are few in number and of comparatively small importance. The heaviest jungles occur in the Puttur and Uppinangadi Ranges, where also are found the most extensive tracts of contiguous forest blocks. Waste and unreserved lands at the disposal of Government retain often considerable tree-growth, varying from scrub to high-forest. In general the country is well-wooded.

SECTION 2.—CONFIGURATION OF THE GROUND.

4. *General.*—The country presents a diversified aspect of strongly eroded profile and a characteristically undulating topography. Low, flat-topped hills, conjecturably once forming an ancient plateau, rise sharply away from the coast, their escarped sides descending into numerous broad well-cultivated valleys. Inland for thirty or forty miles the lowland region is a series of rounded hillocks separated by a network of smaller streams. In the neighbourhood of the ghats, the topography is complicated as a result of transverse strains resulting from early convulsive upthrusts. In the outer sections of the arc, especially towards the south in the region west of Sampaje as far as Adur and Madnur, broken spurs and low ridges extend westwards from the principal range ; in the central section of the arc the prevailing direction of these minor folds is almost due north and south, at an average elevation of slightly over a thousand feet, but broken through at various places by the passage of the principal rivers across them. The ghats proper rise in solid relief to over 3,000 feet above sea-level. The highest peak of the district, belonging to the Kudre-Mukh group, rises to 6,200 feet elevation ; further south, overlooking Subramania, is Pushpugiri peak (5,667 feet), the upper slopes of which are in Coorg.

5. *Elevation.*—The general elevation of the plains is between 150 and 350 feet above sea-level, but afforested ridges mount to 1,000 feet and occasionally as high as 1,500 feet.

6. *Rivers and streams.*—The principal river in the district is the Netravati, which rises slightly east of Kudre-Mukh and flows nearly due south as far as Uppinangady where it joins the Kumaradhari and continues westwards to the sea at Mangalore. Its main tributaries in the upper reaches are the Neriya-hole and Shisla-hole, both typical ghat torrents in the monsoon. The Kumaradhari with its main tributaries, the Gundia-hole, Kallaje-hole and Kombar-hole, drains a very large area extending over practically the whole of Uppinangady and Puttur Ranges. The surplus drain-off therefore, from a total length of 50 miles of ghats and not less than 750 square miles of country possessing one of the heaviest rainfalls in the world drains into the confluence at Uppinangady. The importance of an adequate forest conservancy over the head-waters of this not inconsiderable catchment basin with its extreme gradients in the upper reaches, cannot be overestimated. Uppinangady, at 100 feet elevation, is only 20 to 30 miles from the source of these streams. Beyond Uppinangady, the river approaches more nearly the base-line of erosion ; enormous quantities of suspended matter are carried down during the rains which tend to silt up at the mouth as flood-pressure abates. It is recorded that about 150 years ago, Portuguese vessels of considerable draught were able to navigate safely as far as Panemangalur on the Netravati river, say, 15 miles up stream. This would now be impossible. The large number of river-courses, unfordable except at certain places during the dry season, which converge near the western limits of the forest massifs in the three northern ranges, render communication unusually difficult at all times, especially from north to south, and add materially

to the cost of opening up an undeveloped interior. Kasaragod Range has its separate river-systems in the Paiswani (or Chandragiri) stream entering the sea at Kasaragod, and the Ariakaduku Hole and tributaries which flow out at Nileshwar.

All these rivers differ, from those in South Malabar in having a more rapid fall and less completely eroded beds. Shallows and rapids are numerous. Their courses are comparatively straight, with but minor bends. The red-clay deposits (used in the Mangalore tile industry) excepted, alluvial stretches are rare; stream banks rise with moderate or steep gradient for some distance above the river-beds in most of the upper stretches.

7. *Drainage.*—The drainage throughout the district is good. Marsh and swamp are rare.

SECTION 3.—GEOLOGY AND SOIL.

8. *General.*—The underlying formation consists of metamorphic schists and crystalline gneiss with granite and quartzose intrusions. Extensive areas of surface laterite cover the 'living' rock to various depths, not infrequently of 30 feet or more.

The ghat range is composed principally of gneiss, a hard, often closely-granulated rock, greyish in colour, becoming almost black on exposure. There are frequent intrusions of granite and quartzose rocks, in which mica is a constituent.

9. *High-level laterite.*—On the lower ghats and foothills the original rock appears often much laminated and contorted. The structure decomposes on weathering to a pale, cankered, easily-friable material which finally reduces to a yellowish or pale-red coloured felspathic clay or loam, sometimes reaching to considerable depth. There are several variations of this material, both in colour and structure. In this less advanced stage, nodules of more resistant rock are commonly observed. The weathering process has been accompanied by a ferruginous infiltration, with chemical changes in the iron constituents. This loam or clay is easily penetrated by root-systems, and can support a first class deciduous or evergreen timber-forest of tall straight boles. The topmost layers, may, or may not be, detrital, but where humus soil is present, it is seen to diffuse gradually into the lower stratum. It is important that this red, clayey loam should be distinguished from the more advanced laterite.

10. *Low-level laterite.*—The term here used is not a very good one, but is used to distinguish between the partially lateritised soils described in the foregoing paragraph with the soil which becomes apparent further west of it, after longer weathering or exposure. It is the commonest surface-soil in the plains region. Where under forest, it retains a heavy clayey structure, soft when newly exposed, and apparently homogenous. After exposure it becomes quickly very hard, brittle, and nodular or vesicular in structure. In fully exposed localities, denuded of protective vegetation, this is the common appearance of the surface rock. Gneiss appears with decidedly less frequency in rounded, sometimes foliated humps and bosses penetrating at the tops of hills above the surrounding laterite cap. Exposed fully to erosive action, it becomes inimical to most forms of vegetation except grass and scrub. Surface disintegration of a mechanical nature becomes rapid, and loose gravel is conveyed down to lower levels by the run-off of water. The lower levels thus become a mixture of clay, sand and coarser gravel.

11. *Laterite of climatic origin.*—The laterites and red loams appear to be largely of climatic origin. They are found elsewhere in Burma, Malay and Africa under simliar tropical conditions accompanied by high rainfall. There also, laterite is the final stage of a very complete weathering and the red loam is characteristic of an intermediate stage. In the latter, aluminum is present in the form of a silicate, while in the former it is in the form of hydroxide. Aluminum, iron and felspathic materials are present. Generally speaking, laterite rock becomes apparent on hot, open and exposed localities whereas on the moist, cool slopes with northerly aspect, gneissic soil or red loam is more common.

12. *Soils* (i).—No soil survey on organized lines has yet been carried out in South Kanara. The soils are believed to contain an adequate supply of nitrogen, iron, and (in afforested regions) of organic materials. They are almost certainly deficient in available phosphoric acid, lime and magnesia. Lime however, appears to be present in small but perceptible quantity in the region of Baradka. Parts of Mujur and Yenekal reserves were formerly worked for iron ore, which can be found near the surface. Possibly due to soil deficiencies, cattle breeding is not successful in the district, and large numbers are imported annually from above-ghats. Cultivators collect forest litter and green-leaf manure to dig into their fields, since there is generally inadequate cattle manure to sustain crops.

13. (ii) A fine sandy silt is carried in suspension down the rivers in time of flood and deposited along with heavier gravelly material as floods subside. The deposits are rich in organic material, and where sufficiently aerated, admirable for forest growth, but such deposits are of almost negligible occurrence in the forest regions. The beds of red clay found in the lower reaches are extensively used in the Mangalore tile industry.

14. (iii) Humus loam is a very variable constituent, depending on the nature and history of the forest crop. In first class areas, humus may descend to a depth of 2 feet 6 inches by infiltration, but in deciduous areas rarely to a depth greater than 12 to 15 inches, and generally with a more sharply-defined line of separation between it and the lower layers. Organic matter is held chiefly in solution around the surface particles. Undecomposed litter is generally greatest in the evergreen forests during the dry season, but a heavy matting accumulates in the moist deciduous areas during the first onset of the monsoon, which fact, aggravated by evergreen undergrowth, prevents seeds from germinating.

15. *Relation between soil and forest types.*—A series of soil samples have been collected in various forests of the district under different types of conditions and vegetation, which have been noted. The samples are from surface and lower strata. These have been sent for analysis to the Agricultural Chemist, Coimbatore, and it is hoped that useful facts will be brought to light.

16. *Summary* (i).—The mineral constituents of the soil are themselves of indifferent value to crops, whether forest or agricultural. Fertility is largely supplied by the organic elements of decay.

17. (ii) In a region of exceptional rainfall, leaching and reduction of the top layer by exposure, by repeated surface-fires, etc., entirely transform the crop-bearing capacity of the soil at a rate greater than usual. Results of denudation are very apparent in coastal and densely-populated regions. The hilly nature of the country also facilitates erosive action.

18. (iii) The humus layer, by virtue of its property as colloid protector, appears largely instrumental in maintaining the partially-lateritised red loam elements in their original soft and permeable condition, favourable to root development.

19. (iv) Clear-felling in heavily-afforested moist regions, unless these are very well drained, may result in a raising of the level of the water-table and a perceptible tendency to swampyness, which needs to be guarded against.

20. *Suitability of the soil for forest crops.*—The gneissic and red-loamy soils of the ghats and foothills are capable of producing very heavy crops while the requisite humus conditions are maintained. The ghat slopes in the northern parts of the division, particularly those of Miyar, Charmady and Naravi sections are however too steep in many parts to support a good crop, and the soil is shallow and rocky. Amongst the more valuable species which find particularly suitable soil conditions are *Artocarpus hirsuta, Hopea parviflora, Dalbergia latifolia* (Rosewood), *Xylia xylocarpa, Terminalia paniculata* and *Terminalia tomentosa* (*crenulata*). South Kanara has been called the " Home of Hopea." This species, along with *Artocarpus hirsuta,* although attaining to superior dimensions on good, deep, well-drained loam, is not particular as regards soil or aeration, provided that the initial biological and edaphic site-factors are suitable. *Mesua ferrea,* although indigenous to the district and gregarious in a few localities, does not for some reason reach to very large size. *Dalbergia latifolia* grows particularly well in the sub-ghat zones ; it grows fast, is usually sound, and contains a good proportion of heart-wood. The Subrahmania forests were reported fifty years ago to contain excellent Rosewood as well as Aini (*Artocarpus hirsuta*), both these species having been since largely cut out. Teak is indigenous to only a few localities, and the soils are probably very largely unsuited to this species. The deepest and richest detrital loams are naturally to be found in valleys and pockets at the foot of the ghats and other slopes. These however, are just the areas taken up already by cultivation and warg-lands except in the thinly inhabited localities, it being a particularly noteworthy feature of the forests in this district that they occupy mainly and almost exclusively the hill-slopes overlooking cultivation which ramify in narrow straggling stretches into all important valleys. The largest patches of indigenous teak were probably at one time those known as the " Sullia teak jungles," stretching eastwards of Parappa along the Paiswani river valley, but now mostly destroyed to make way for cultivations. Sampaje reserve contains indigenous teak in the mixed dry-deciduous, and bamboo forests, chiefly at lower elevations adjoining enclosures, but also higher up on ridges. The ghat slopes of Maloth, not yet formally reserved, are also reported to contain some of this species. It is difficult now to ascertain how much of the teak in Parappa reserve is from natural seed or coppice, and how much is the result of " reboisement " operations some 50 or 60 years ago, but undoubtedly this tract, although apparently no more essentially teak soil than many other localities, did contain a considerable number of teak trees before kumri or reservation. Our experience is yet inadequate for us to be able to judge finally upon the possibility of growing teak on South Kanara soils. While the pole-crops resulting from kumris in Aletti, Mandekole, Medinadka and Adur blocks cannot be described as entirely satisfactory, the present condition of these cannot be ascribed wholly to unsuitability of locality or soil, since the tending given them has been inadequate from the very beginning. Laterite, if not of too advanced a type, does not appear unsuitable ; some excellent trees

of this species, giving fully 30 to 40 feet of uninterrupted bole are found adjoining Kuinthodu and Bantwadi enclosures in Sampaje reserve. These boles are unfluted and practically free from epicormic branches. The laterite is of a heavy, soft, clayey consistency, generally covered by a good forest humus, but presenting the usual appearance after quarrying and wherever it has become exposed to sun and atmosphere. It is observable that the laterite *rock* in both the above localities makes its appearance only in those fringes of the forest most exposed by repeated fires escaped from the enclosures, whereas in interior places a moist cool condition is almost invariably associated with darker loams and gneissic boulders at the surface. Teak, in fact, is most *rarely* found on those soils which might be thought to be the richest and most suitable. This is possibly due to the fact that the very circumstances which have maintained those soil conditions are also those which would *ipso facto* effectually prevent the natural appearance and survival of teak seedlings, i.e., absence of fires, with consequent heavy undergrowth and middle storey. On the other hand, repeated burning appears to have produced, or to have been indirectly responsible for, lateritic conditions of soil, or a heavy crop of bamboo. Again, it is noteworthy how clear-felling of a moist deciduous area containing an *apparently* good, deep, loamy soil may bring to light after a single monsoon an unmistakable laterite outcrop.

SECTION 4.—CLIMATE.

21. *General.*—The sea-board situation between the Western Ghat Range and the Indian Ocean assures a humid equable climate throughout the year.

22. *Temperature.*—Both diurnal and annual temperatures rarely exceed the limits of 75 and 95 degrees near the coast, but inland nearer the hills greater ranges are usual, due to the alternation of sea and land currents, the latter descending from higher altitudes at night. Cloud, rarely absent during the months from March to November, prevents radiation of heat. During the monsoon months the temperature is greatly reduced by the almost total absence of sunshine. Day temperature at ground level is always markedly lower in the evergreen jungles, owing to the several layers of canopy.

23. *Rainfall.*—The average annual rainfall at Mangalore during the last three decades has been 129 inches. Rainfall statements for Mangalore and other stations are appended.

24. *Comparative statement showing the distribution of rainfall in the different localities of South Mangalore* :—

Annual rainfall in inches.

Year.	Uppinangady Range Ghat Section—Shiradi, Chamadi and Mujur stations. (Averages.)	Uppinangady Range Plains Section—Beltangadi, Karakodi, Managundi and Kokkada stations. (Averages.)	Kasaragod Range, Parappa station.	Mangalore station.	Puttur Forest Range, Baradka station.
	INCHES.	INCHES.	INCHES.	INCHES.	INCHES.
1910	206·67	129·72	..	118·73	..
1911	322·83	168·32	..	100·98	..
1912	187·15	214·68	..	145·71	..
1913	161·64	163·17	..	110·25	..
1914	207·51	146·71	..	147·66	..
1915	163·91	120·13	..	106·78	..
1916	185·18	181·06	..	122·41	..
1917	168·31	168·72	..	136·80	..
1918	177·33	124·21	..	100·79	..
1919	188·24	156·49	..	119·02	..
1920	210·25	175·39	..	122·33	..
1921	226·31	157·92	..	137·69	..
1922	174·37	182·80	164·59	138·69	209·16
1923	268·72	155·03	188·21	139·41	219·29
1924	269·77	126·13	167·20	142·66	207·89
1925	147·35	149·76	183·03	145·86	189·57
1926	185·44	198·14	133·47	115·77	168·86
1927	193·50	167·38	179·92	136·83	206·93
1928	184·68	164·75	121·99	127·39	148·33
1929	168·76	180·28	183·99	145·35	212·46
1930	198·58	208·55	135·77	..	212·61
Average ..	**199·83**	**163·78**	**162·02**	**128·05**	**197·23**

25. *South-west Monsoon.*—The burst of the south-west monsoon usually early in June is the meterological climax of the year. The preceding months of April and May are marked by high day temperatures, sultryness and thunderstorms of increasing severity as the monsoon current gathers force. In the ghat region, local thunderstorms during March are not uncommon. These precipitations become later an almost daily feature in

the afternoons, accompanied by a drop in temperature and high local winds. Sometimes the temperature fall may be so considerable as to maintain a heavy groundmist and cloud for several hours during the following day. After the first onset, interruptions during the month of June with periods of sun-shine of from ten to fourteen days are not uncommon. During July and August however, rainfall is almost incessant and occasions heavy floods along all watercourses. Communications to the foot-hills are extremely difficult and not infrequently impossible. Food and other supplies for sawyers and felling coolies have to be stored in granaries in places like Baradka which are cut off from all wheeled traffic during this time. Rainfall abates somewhat in September and floods subside.

26. *North-east monsoon.*—This, although of shorter duration and much less intense than the south-west monsoon, brings often considerable precipitation during October and November. The interval between the two prevailing currents is characterized by thunder-showers.

27. *Dry season.*—Severe drought is almost unknown in South Kanara, there being usually ample water-supply from river-courses or from perennial springs which rise in the forest and are drawn off by channels at nominal rent for irrigation purposes. Rain in the months of December to March is trifling, and usually confined to local showers on the ghats. The dry season not infrequently extends as late as May, and is then marked by heavy forest fires. A ground-mist, or heavy dew, is however no uncommon feature in the sub-ghat region; this, combined with possible thunder-showers, renders a burning season difficult to time successfully.

SECTION 5—WATER-SUPPLY.

28. Water supply for the camps within forest areas is always adequate. Apart from streams and perennial springs mentioned in the foregoing paragraph, wells are dug at all forest camps, and are not known to run dry.

SECTION 6—DISTRIBUTION AND AREA.

29. The reserves coming under this plan, together with the area of each, and listed according to ranges, are named below. The extent in acres of each reserve recorded in the statement is that given in Section 16 Notification; this does not agree in all cases with the corresponding area given in the Survey of India maps (2 inches = 1 mile scale), and the differences have not yet been reconciled. Reserves are listed according to the new distribution of ranges prescribed in this plan.

30. *List of reserved forests in South Mangalore Division*—

	Name of reserved forest.	Area in acres.	Number of the page and date of Part I Gazette containing the Section 16 Notification.	
	(1)	(2)	(3)	
	UPPINANGADY RANGE.			
			Page numbers.	Date.
1	Charmadi-Kanapady (Part)	4,998·00	501–503	7th June 1898.
2	Dharmastala Mundaje	4,320·00	1178–1181	2nd October 1894.
3	Dharmastala Extension I	1·14	135	5th February 1907.
4	Do. do. II	636·80	1202	3rd December 1907.
5	Do. do. III	590·08	1243–1244	17th December 1907.
6	Do. do. IV	867·20	1203	3rd December 1907.
7	Dondalarabi	1,016·30	498–499	4th July 1905.
8	Dadanthamale	2,342·40	770	22nd September 1908.
9	Miyar	14,496·88	1334–1336	30th August 1900.
10	Mundaje Kap	476·20	..	19th December 1905.
11	Nidle	3,258·00	1181–1183	24th July 1900.
12	Bhagimale	6,976·00	275	5th April 1887.
13	Kadimbilla	1,056·00	211–212	6th February 1900.
14	Kombar	11,185·15	1819–1821	1st October 1902.
15	Kidu	6,520·40	1550–1553	19th October 1900.
16	Konaje	5,823·40	53–56	15th January 1901.
17	Kunthur	3,285·20	460–461	3rd May 1904.
18	Do. Extension I	17·90	306	11th April 1905.
19	Do. do. II	566·40	425–426	19th May 1908.
20	Mujur	9,970·60	906–909	21st May 1901.
21	Nerankimale	3,164·10	1925–1926	23rd December 1899.
22	Padnuru	4,023·70	1588–1591	6th November 1900.
23	Porkala	4,507·50	1195–1197	4th August 1900.
24	Suvarmale	1,481·60	460–461	2nd June 1908.
25	Shiradi Sisla	21,863·18	275	5th April 1887.
26	Do. Extension I	1,081·60	586	1st May 1900.
27	Do. do. II	140·80	549	1st July 1908.
28	Do. do. III	486·40	} 20	
29	Do. do. IV	230·40		4th January 1910
30	Shibaje	3,198·40	112–1194	4th August 1900.
	Total area ..	1,18,581·73		

	Name of reserved forest. (1)	Area in acres. (2)	Page numbers. (3)	Date. (3)
	Puttur Range.			
1	Narimogar	1,445·10	1266	6th December 1904.
2	Aivaranad	1,758·00	881	31st October 1905.
3	Aranthakallu	803·80	589	1st May 1906.
4	Bantamale	2,384·00	1087	16th October 1906.
5	Do. Extension I	12·80	..	
6	Do. do. II	33·30	..	
7	Balpa	2,087·10	421	20th March 1906.
8	Do. Extension	1,478·40	1118–1120	21st November 1911.
9	Bellare	676·48	1319–1321	7th December 1909.
10	Devachalla	3,264·00	32–33	14th January 1907.
11	Dolpadi	890·80	791	10th October 1905.
12	Kalanjimale	1,555·30	1102	23rd October 1906.
13	Do. Addition	5·70	792	6th August 1912.
14	Kilarmale	11,995·52	231–283	16th March 1909.
15	Do. Extension I	5·00	547	18th July 1905.
16	Do. do. II	27·50	281–283	16th March 1909.
17	Do. do. III	12·20		
18	Do. do. IV	7·00		
19	Do. do. V	3·10		
20	Do. do. VI	12·40		
21	Do. do. VII	87·50	450	5th April 1910.
22	Do. do. VIII	43·10	59	10th January 1911.
23	Kallapattamale	1,076·56	331	25th April 1905.
24	Kaniyarmale	3,056·60	..	2nd January 1906.
25	Kiribag	9,417·02	1104	23rd September 1907.
26	Nalkur	5,795·84	989–992	24th November 1906.
27	Paikadamale	1,382·40	..	2nd January 1906.
28	Subramanya	7,204·20	..	2nd January 1906.
29	Do. Extension	4·80	704	3rd August 1915.
30	Veerakamba Extension I	836·60	777	17th July 1906.
31	Do. do. II	613·00		
32	Yenekal	2,432·50	437–438	13th June 1905.
33	Yenmuru	2,745·00	381–382	6th March 1906.
34	Jalsur East	807·68	169–171	12th February 1907.
35	Do. West	2,223·36		
36	Anegundi	3,347·84	31–32	8th January 1907.
	Total area	**69,531·50**		
	Kasaragod Range.			
1	Pumale	4,871·68	733–734	23rd July 1907.
2	Sampaje	11,949·56	145–149	1st February 1908.
3	Do. Extension I	14·00	145–149	Do.
4	Do. Do. II	23·00	145–149	Do.
5	Thodikana	2,858·88	160	12th February 1907.
6	Adur	5,073·00	132	30th January 1906.
7	Aletti No I West	3,129·60	166	12th February 1907.
8	Do. II East	5,733·76		
9	Aletti Addition I	3·58	726–727	10th August 1915.
10	Do. II	14·40	621	28th April 1914.
11	Do. III	6·40		
12	Bantaje	2,384·00	484–487	22nd March 1910.
13	Kanakamajalu	1,952·00	59–61	15th January 1901.
14	Kannadka	1,318·40	425	12th May 1908.
15	Karadka	2,859·00	804–805	19th July 1904.
16	Muliyar	2,116·00	1857–1860	12th December 1899.
17	Mandekole	5,511·68	1259	18th December 1906.
18	Do. Addition I	0·48	2088	27th October 1925.
19	Medinadka East	611·20	162–163	12th February 1907.
20	Do. West	2,455·64		
21	Do. Extension	4·18	639	2nd July 1907.
22	Parappa	2,184·30	271–272	18th April 1892.
23	Do. Addition I	97·28	1811	29th November 1910.
24	Do. do. II	0·74	1100	12th November 1912.
	Total area	**55,172·76**		

Column (3): Number of the page and date of Part I Gazette containing the Section 16 Notification.

Grand total **243,285·89** acres. This total does not include areas of forest now under reservation.

Section 7.—State of the Boundaries.

31. *Natural boundaries.*—Forest reserves are to some extent bounded by natural features, where they abut on to rivers and streams, but natural boundaries are the exception rather than the rule in South Kanara. Where Kanara adjoins the State of Mysore, the tops of ridges are largely, but not invariably, followed; the Coorg-Kanara boundary on the other hand, is almost entirely artificial, of complex shape and following no particular feature for long.

32. *Artificial boundaries.*—Most of the boundaries follow approximately those allotted during the settlement survey begun about the year 1878 and demarcated subsequently by cairns and cleared lines. The complications arising out of private tenure, 'kumaki'

and other claims, have inevitably resulted in complex boundaries of considerable length. Reserves are for the most part on hilly ground overlooking wet cultivation and in many instances are comparatively small isolated blocks almost or entirely surrounded by warg land. The boundaries accordingly follow an arbitrary line around the foot of a ridge or hill. Those forests formerly in the Sullia and Amara maganes were dealt with on rather simpler lines, with respect to which the following is an extract from the report of the Forest Settlement Officer: "The provision of a reasonable margin between the edges of cultivation and the reserve boundary, the exclusion from the reserves of most of the minor kans and of almost all the banes, lying as they do generally at the very edges of the cultivation, the exclusion as far as possible of other private rights, the adoption wherever feasible of natural boundaries such as streams for the reserve, and the nature of the ground and the forest growth therein, were the chief considerations which were kept predominantly in view in the determination of the final boundaries of each block; and owing to the absence in these two maganes of the kumaki system which involves the exclusion of a belt of land parallel to cultivations in all their ramifications, it has been possible to secure for these blocks far straighter and shorter boundaries than are to be met with in the generality of South Kanara blocks."

33. *Permanent demarcation.*—Permanent demarcation of an ambitious order, consisting of a line of stones or a trench along the external boundary was begun during the first decade of the present century in some blocks of Kasaragod Range, viz., Muliar, Karadka and Parappa. This work having been found not only very costly, but incorrect with regard to Section 16 Notification, the operations were suspended. In Parappa reserve, only 6 miles were thus completed. The external lines, cleared of growth, are officially complete for all reserves in this plan. Cairns are usually well-built and of adequate number, although rarely tied in by survey to definitely known points. Lines are also on the whole well-maintained, but owing to the vast length of boundary and the rapidity with which vegetation takes possession of the ground anew after clearance, definition in the more remote localities of Kiribag, Kilarmale, Subrahmania, Aranthakallu, Miyar and Charmady is not always easy. At present the boundary separating Charmadi reserve from the Neriya Cardamom Estate, which occupies a considerable ghat area, is entirely obscured. It is to be doubted to what extent original cairns now remain, and their location will require much search. In the majority of the above instances, however, these forests are unlikely to suffer encroachment by neighbouring cultivation. Where blocks adjoin recently-surveyed villages survey stones are readily discernable, but in the case of old surveys where 'kumaki' rights obtained, stones were not always planted. Very occasional instances have been noted where survey stones were discovered within the reserve boundary. Where no 'kumaki' rights were admitted, the forest boundary usually abuts closely on the margins of patta lands.

34. *Mysore and Coorg boundaries.*—The major portion of the Mysore boundary was inspected by the District Forest Officer during the year 1929–30. The boundary was on the whole well-maintained, except for a few defects noted in that officer's report. No cutting or burning has been done along the Mysore side of the line. The Coorg boundary is fire-traced annually, but no report is called for as is the case with the Mysore boundary. Some correspondence arose between Madras and the Coorg Administration in 1928 regarding the clearing of the common boundary, by which Coorg claimed half the cost of works done by them. The Madras Government was informed by the Chief Conservator that so far as reserved forests were concerned, the Forest Department had paid for clearing to the extent necessary and that nothing was due to Coorg. No South Kanara-Coorg boundary description appears available in the district.

35. *Reconciliation of differences in reserve boundaries with Section* 16 *Notifications.*—The original settlement unfortunately left much to be desired in the descriptions made of reserve boundaries in Section 16 Notifications. Re-survey of Kasaragod taluk by the Madras Revenue Survey Party at Cannanore was undertaken at the beginning of 1925. The District Forest Officer was requested by the Survey Officer to have the boundaries of all reserves in that taluk cleared for re-survey operations following the lines that they should run, and the Survey Party would follow those lines. At a meeting in February 1925, of the Assistant Director of Survey, the Conservator of Forests, and the District Forest Officer certain instructions were issued. It was pointed out that owing to the vagueness of Section 16 Notifications a resurvey of the forest boundaries was obviously advantageous; that primary consideration on survey was whether the new lines correctly represented the intention of forest settlement. It was believed that the boundaries of reserves in South Kanara as a whole were incorrect but that it would suffice if the existing lines were adopted where their adoption would not lead to inclusion of land within the reserve originally intended to be excluded at the settlement, and provided that they coincided at points where the original boundary had been exactly tied to a known point. Finally, revised Section 16 Notifications would need to be prepared. It was decided that the Forest

Department should do the preliminary verification work, and prepare a cleared line in accordance with requirements. In complicane with the above, Muliar reserve was verified by a special duty ranger in July 1925. In the following month Mr. Madan, then District Forest Officer, submitted a report to the Chief Conservator, of which the principal points, based on experience in Muliar reserved forest were submitted as follows :—

The fourteen reserves of Kasaragod taluk could be classified into two different categories of accuracy with respect to their Section 16 Notifications. Those reserves which fell in the Sullia-Amara maganes, having 'kan' and 'bane' rights instead of kumaki privileges, were well notified, and their cairns were tied to known points. These reserves were Pumale, Jalsur East and West, and Anegundi. In the other reserves of Kasaragod taluk, original notifications under Section 16 were indefinite. While the lines on the ground represented sufficiently the intentions of settlement, the extent of kumakis allowed to each warg differed from those awarded at the time of settlement, and often fell short of the sanctioned width of 100 yards. A sum of Rs. 1,350 was sanctioned for verification work, and an Extra Assistant Conservator with two special duty rangers were put on the work.

Resurvey operations in Kasaragod taluk were completed in 1927, and sketches were forwarded to the District Forest Officer for verification with the existing resurvey boundaries. In reconciliation of resurvey observations with old Section 16 descriptions the following principle embodied in Board's Proceedings No. 139 of 18th April 1916 is applicable :—

(i) Petty discrepancies may be ignored ;
(ii) Large discrepancies should be corrected by the issue of a revised notification ;
(iii) In exceptional cases, where large areas of real forest growth are involved the line may be recut to agree with the new notification.

Item (i) was qualified by the clause that such minor discrepancies might be ignored only where Section 16 description was vague in the first place, or open to misconstruction ; further, that where the notified boundary was clear but subsequent demarcation had deviated from it and it was proposed to retain the demarcated boundary, the inclusions and exclusions involved should be dealt with under sections 4 and 24 of the Madras Forest Act.

It was ordered by the Conservator that it was unnecessary for the Department to verify whether the resurvey had followed the lines cut by the department. It was necessary however that copies of resurvey sketches should be compared with the original Section 16 Notifications, since resurvey had in many cases given fresh numbers to survey fields and also in order to observe whether there was at least a general parallelism between the resurvey boundaries and those given in the original notification. The resurvey sketches were forwarded to the Range Officer, Kasaragod, for verification. On inspection that officer reported that several divergencies were to be observed when the two sketches were superimposed both in the extrusion of forest land and in the intrusion of patta lands. The Conservator ordered that a draft notification for Parappa reserve should be prepared as a test instance, but this could not be completed since a portion of the boundary was in unsurveyed territory, for which no plottable data could be found. The matter remains under correspondence at the present time.

Section 8.—Legal Position.

36. *General.*—All forests are the absolute property of the State. The numbers and dates of Section 16 Notifications for all reserves are maintained in the District Office, all rights admitted at settlement are also enumerated.

37. *History of land and forest administrative records.*—It is unnecessary to refer to the early political history of the district in any great detail. South Kanara was formerly called Tuluva, and Tulu remains still the spoken language of almost one-half of the population in South Mangalore Forest District. South Kanara has never been a separate kingdom, having been always feudatory to external rulers. Up to the time of British occupation the history of the tract has been one of repeated invasions. The Jains were formerly the ruling class ; the local Jain Chiefs were overthrown in A.D. 1336 by Vijayanagar. Prior to this there had been also an invasion by Brahmans under one of the Kadamba kings. Under Vijayanagar some measure of prosperity and a fixed system of revenue was attained. The Portuguese began to settle along the coast in the 15th century. During the 16th and 17th centuries the country was controlled by the Mysore dynasty at Bednore, during which time the Jain and Brahman Chiefs recovered a good deal of their old independence. In 1737, the British of the East India Company's factory at Tellicherry obtained a monopoly of all cardamoms and pepper from certain areas. The latter half of the 18th century is largely a story of general impoverishment of the country after the capture of Mangalore

by Hyder Ali followed by wars between the British and the Mysore dynasty. In the Second Mysore War, Mangalore garrisoned under Colonel Campbell, was besieged by Tippu and capitulated finally in February 1794. After the fall of Seringapatam in 1799, Captain, afterwards Sir Thomas Munroe, was appointed Collector of Kanara. During this time the Coorgs had exploited the country very considerably. In consideration of their help to the British, the Sullia and Amara maganes were given over to them, but after the annexation of Coorg in 1834 this part of the district again passed to the control of the Collectorate of Kanara. In 1862 the country north of Coondapoor taluk was transferred to Bombay Presidency.

38. *Revenue settlement.*—A new 'Tharao' assessment of the district was begun by Sir Thomas Munroe in the year Durmati (1800–01). The country had fallen into a very bad state in consequence of the ravages made upon it during the previous half-century. Sir Thomas observed that Canara had originally been a highly improved country, more prosperous than any province under native power in India but ruined by the excessive taxation levied for the support of Hyder's military operations in other quarters. The ancient proprietors were rendered almost extinct and land was largely unsaleable. Lands had accordingly to be forced upon the cultivators. Of the accounts maintained by the shanbogues prior to British administration, many were lost. In the year 1812 a settlement was made by the Coorg Government in Sullia and Amara maganes. In the rest of the country the old 'sarasari' assessments were retained, albeit unequal and somewhat severe. Regular survey was not attempted until 1889 and revenue settlement begun in 1894 was continued until 1903. Settlement conformed largely to the almost universal arrangement dating back to the time of Vijayanagar in the fourteenth century, namely, that known as 'warg' tenure, by which the bulk of the cultivating classes owned their lands as private property and paid lump assessment over the whole warg at wet rates after allowance had been made for less profitable land.

39. *Waste lands and 'kumaki' holdings.*—In the early days of British administration Government did not pretend to exercise proprietary right over uncultivated or forest land except in the case of unclaimed waste and escheated estates. Lands adjoining an estate were called 'kumaki.' Originally the term had no precise limitations and appears to have been accepted as the implied right of the cultivator to use the adjoining forests for the procuring of manure-leaves, brushwood and small timber for agricultural purposes, the provision of grazing, fodder and thatching grass, etc. The land was not common property but apportioned into separate lots, each lot being enjoyed by the individual landholder. The crest of the hill dividing cultivated valleys formed the natural boundaries of the holdings on either side of the ridge and was called the 'netticut' limit. This was the boundary usually adopted in mul-pattas, grants from native princes, and in all old documents. The early British administrators did nothing to modify popular usage and notions in this respect and thus tacitly admitted the forests to form an integral part of each proprietary estate limiting however the basis of assessment to the cultivated portions only. Thus the rights of the people of South Kanara with regard to the forests were from the beginning treated with almost unique deference. Sir Thomas Munroe wrote in regard to the Panch Mahals, of North Kanara, that all lands except gardens belonged to the sircar, while he, along with his immediate successors, treated a large portion of the forests in Kanara proper as the private property of the wargdars. Mr. Maltby in 1839 and Mr. Blane in 1848 were the first to question the correctness of this view. Mr. Blane wrote that he held adjoining waste and forest land under the original terms to be "essentially an adjunct to, and in connection with, the cultivated lands, and the right to them to have been a modified right, only to be enjoyed for the purposes for which they were held as above stated" (i.e., for domestic purposes). This principle had been generally adopted without challenge in the courts of law since the middle of the eighteenth century. Thus land within 'netticut' limits was no longer refused, as a matter of course, to applicants desiring to take it up for cultivation, and in the order of Government sanctioning the Forest Rules of 1864, the exclusive rights to forest lands by wargdars was limited to a space of 100 yards beyond their cultivations. The Board of Revenue remarked in their Proceedings of 30th January 1865, No. 490: "Thus it appears that, according to the acknowledged and long-established custom of the district, individual ryots may at pleasure fell trees other than the prohibited kinds within 100 yards of their cultivated lands, although not in their wargs, and sell such trees within their villages; and also that beyond this distance the cultivators of each valley have the common usufruct of the open hill-sides up to the water-shed dividing each valley, but must not cut down trees growing in this common land." Thus the Government, although limiting proprietary claims, could not reserve land on hill-sides adjoining cultivation without first making provision free of charge for, the *bona fide* domestic and agricultural requirements of the cultivators. The origin of the term 'kumaki and its more particularized application to land within 100 yards of cultivations is obscure, but the idea seems to date from the term of office of Mr. Harris, who, as Collector in (about)

the year 1823, called for a list of Government forests and at the same time assigned to those estates which had no forest lands attached to them, a strip 100 yards in width adjoining the Government forests. The nature of Mr. Harris' orders seems to have been misapprehended to the effect that Mr. Harris had allotted to each wargdar the sircar forest or waste within 100 yards of his holding. The word 'kumaki' does not appear to have been used specifically in this connection until 1845, with regard to the particular circumstances of the forests of the Adur magane, which were claimed respectively. but unsuccessfully, by both the Adur temple and by the wargdars. The Sarishtadar, on his showing the inadequate basis of the claims put forward, then proposed that as the wargdars had no private forests, they should be given the privilege of retaining as "kumaki" (i.e., "assistance") the 100 yards around cultivated land allowed elsewhere by Mr. Harris. The instance above-quoted is no doubt typical of the state of affairs found by Mr. Blane, who remarked with regard to the tremendous legal difficulties encountered by the district authorities that there was no claim, however absurd, that the wargdars of South Kanara were not prepared to make. In 1874, Government relinquished all claims over kumaki giving holders the right to dispose of the produce in such lands without interference. The effects of this policy (albeit a temporary one) are described elsewhere. Rules for 'kumaki' holdings were again revised with the publication of Forest Rules, described hereunder.

40. *Early forest settlement.*—The lists of "Government Forests" obtained by Mr. Harris were burnt by the Coorgs in 1837; but the taluk copies for a considerable part of the district were subsequently found and showed 67 jungles of an estimated area of 250 square miles. Government took no further steps in forest reservation until October 1874 when they issued a Government Order which directed the Collector to submit proposals for the demarcation of valuable forests admittedly the property of Government; and in the following year they directed that the forest officer should submit lists of the forests preparatory to notification. The Forest Department having practically nothing to guide them in the task of deciding what was and what was not Government property, submitted a list containing 71 "blocks" and 2,432 "forests", which was probably the maximum possible. Mr. Webster and subsequently Messrs. Comyn and Sturrock undertook the extremely onerous task of enquiry. Of the above 2,432 forests about 41 were finally considered to be private forests, and 2,391 to be Government forests. Of those which were investigated prior to the passing of the Madras Forest Act of 1882, no enquiry was made into rights of way and water but reports were filed, indexed and subsequently dealt with.

Mr. Sturrock adopted the classification laid down in sections 10 and 11 of the Madras Forest Act; his recommendation as regards Class II forests where rights to 'kumaki' were claimed, and Class III forests where partial rights to pasturage or forest produce were claimed, viz., that although the Forest Settlement Officer might decide that the claim did not legally exist, it should be still allowed to be exercised as a privilege to the extent compatible with proper conservation and adequate to the real requirements of the villagers, was approved by the Secretary of State, and Government approved generally of the report in their Order No. 932, Revenue (Forest No. 124), dated 12th August 1884.

41. *Forest Rules for South Kanara,* 1884.—The general rules circulated with Board's Proceedings, dated 3rd October 1883, No. 2951, were not considered entirely suitable for the peculiar circumstances of South Kanara, with its scattered cultivation and complex distribution of occupied lands entirely unsurveyed. Accordingly in the new rules for South Kanara it was permitted for the Collector and the Conservator jointly to extend, as necessary and convenient, the area of reserved land. Reserved lands were to be administered by the District Forest staff, while the protection of reserved and classified trees and minor produce should be in the hands of revenue and village officials. Under rule 5, a clause was inserted providing that long leases for cardamom cultivation might be granted for such periods and on such conditions as might be determined in each individual case. Under rule 6, ebony, catechu, and cinnamon were added to the general list of reserved trees in "kumaki" as well as other lands. The substitution of stump fees in place of seigniorage per candy was proposed by Mr. Cherry in order to meet the difficulties of prompt measurement in the case of scattered trees in unreserved and 'kumaki' lands. Under rule 7, the forest rights of the people with regard to "kumaki" lands were defined. Formerly the Public Works Department, and to some small extent the Forest Department, had asserted the right to fell reserved trees in 'kumaki' land, which occasioned discontent. This was prohibited in 1868. After 1874 all restrictions were withdrawn, but when again five years later the old rules were reverted to, the felling of reserved trees free of charge for the wargdars' own use was permitted, and this practice was allowed under the new rules to continue. Assessed kans were for the purpose of the rules treated as 'kumaki'. Timber transit rules were laid down and 28 tannah-sheds were defined. In 1907–08 the 'kumaki' rules were amalgamated with the rules under section 26 of the Madras Forest Act. Rules under section 33 were also published for the management of assessed kans.

42. *Banes.*—In the Amara and Sullia maganes which were attached to Coorg prior to 1834, pieces of forest and waste-land, called " banes ", were assigned to each landholder and took the place of " kumakis " elsewhere in the district, the main difference being that they do not necessarily adjoin the cultivation for which they are provided.

43. *Pepper and cardamom forests.*—At the beginning of British administration a large number of pepper forests or kans especially in Puttur taluk, were found to be in the enjoyment of ryots, on assessment by the proprietary estates. While they were perhaps originally considered as part of the estates, Government later asserted forest rights over them and care was taken in the settlement order of fasli 1262 (A.D. 1852) that these kans were not destroyed. Permission to fell trees thereon was also declined subsequently but the general enjoyment of pepper-growing was not interfered with. The claims recognized were only such as were entered in the accounts of the year Durmati (A.D. 1800–01) or in the year Angirasa (A.D. 1812). Mr. Sturrock remarked in a letter to Government in 1883 that the only forests which had escaped destruction in the Bekal taluk except the crest of the ghats were the pepper and cardamom forests, which were highly valued.

44. *Kumri cultivation.*—The method of shifting cultivation called " kumri ", comparable with " taungya " in Burma, was formerly widely practised throughout the entire district. It was the principal mode of existence of numerous families, called " Mahrattis " and " Malekudies." Their wanderings were to some extent checked by restrictions applied by the local village land-owners who imposed rents or fees for kumri in lands held to belong to them. Rice, ragi, and gram were the crops usually raised for about two or three years in succession, but rarely longer. During early British administration the system was countenanced with sole modification that " Sirkar Kumri " assessment was levied over all forest land not admitted as warg. The widespread nature of this practice was described in a letter by the Collector, Mr. Blane, in 1840. The Revenue authorities gradually became cognizant of the wholesale destruction going on in the district. Dr. Cleghorn reported in 1858 that :—" The waste . . . is checked to a great extent in South Kanara but has not altogether ceased. The exertions of the Collector and Sub-Collector have, however, been very successful in keeping under this destruction." " Sircar " kumri was abolished by order of the Madras Government in 1860, but clandestine kumris were carried on in the more remote quarters of the district for several years after this. Government also decided that past enjoyment of such privileges on forest land gave no proprietary right to the land. Mr. Foulkes, writing in 1902 noted that :—" Until within 60 to 30 years kumri was practised throughout both taluks under review (Puttur and Uppinangady). The intensity of the kumri varied ; those reserves along the ghat foot and on the lower slopes of the ghats being the most favoured, while those nearer the coast escaped more lightly. The reserves in Uppinangady Range which appear to have been the most recently kumried are Dharmastala, Kombar, Charmadi, Mujur and Konaji."

45. *Kumri in Kasaragod Taluk.*—Kasaragod taluk, especially the Nileshwar magane (formerly known as Bekal taluk), and areas south of the Chandragiri river, were exceptionally treated. The reasons ascribed by the Board were that " The south part of Bekal not only adjoins Malabar, where kumri is unrestricted, but also forms part of the old Nair kingdom and has still its Nair population and customs. The idea of an inherited right to the waste does not appear to be extinct and the kumri cultivation is there carried on as a regular part of their farming by the resident landholders and not by wandering tribes as in North Canara." In the Government Order of 1860, kumri in Bekal was accordingly allowed " to continue for the present." The regulation of kumri was however defined in a set of rules proposed by Mr. Webster and enclosed with Board's Proceedings No. 1222, dated 21st March 1871. In these rules annual permits were given and the cultivation annually measured up. Mr. Cadell, then District Forest Officer, had in 1866 described this arrangement as farcical, as it was impossible to survey accurately hilly jungle by the instrumentality of untrained subordinates not unopen to corruption, and the wargdars themselves were only able to guess at the extent to which they had felled. A new set of rules was drawn up in 1876, based on a lump annual assessment, irrespective of the extent actually cultivated. All restrictions having however been only just withdrawn by Government in 1875, kumridars were naturally averse from compounding, considering that nothing further should be levied on the cultivation than the old shist and shamil. In the first year of British administration (Durmati), the total extent of kumri holdings over which the wargdars' rights extended was shown to be 34,791 acres. The extent to which encroachments had been going on in the interval is shown by the fact that in 1850 the kumri lands claimed by the wargdars by virtue of title-deeds or prescriptive right had risen to 92,034 acres. Mr. Comyn when drawing up the new rules, noted :—" Under the present system the wargdar fells when and where he chooses, no restrictions being placed on the extent or as to the locality of the clearings." The work of inspection was done by two monigars who made a tour at the close of the rains and surveyed all the cultivation brought to their notice by the potail and villagers in each place visited. Government finally framed a new

set of rules in G.O. No. 1054, Revenue, dated 29th August 1883, the gist of which is as follows :—(i) The cultivation of kumri to be strictly prohibited in virgin forests, cardamom and pepper forests, forests which had not been cultivated for 12 years or upwards, and all forests outside the tract recognized as kumri attached to wargs ; (ii) a register to be prepared showing the limits within which each wargdar was allowed to practise kumri ; (iii) annual clearings to be left to the discretion of the wargdar, the assessment being collected as a fixed annual sum ; (iv) nothing under the rules to preclude Government from reserving any land then occupied for kumri under the Madras Forest Act of 1882 ; and (v) all forests not entered in the returns submitted in fasli 1258–1260 to be excluded. The compounded assessment, with certain exceptions, amounted to seven times the shist and shamil. In 1894 a report was made by the Special Settlement Officer, Malabar and South Kanara, on the general effect of kumri in Hosdrug section as follows :—" In these villages I saw hundreds, nay thousands of acres of the most dismal waste land. The surface soil had been washed away and the land consisted of sheets of laterite rock with a few tufts of coarse grass and some miserable shrubs. The village officers admitted that this had been formerly warg-kumri, and that kumri cultivation had reduced it to this present condition. The kumri lands as demarcated far exceed in extent the kumri-lands shown in the wargdar's chitta. The shanbogues of Pullur and other shanbogues told me that ' Government land has been included in warg kumri by the surveyors who demarcated exactly in accordance with the requests of the wargdars '." It was reported in the Madras Forest Administration Report for 1896–97 that a ryot who according to his chitta was entitled to 11 acres of kan land, had included over 300 acres in his kumri.

46. The pinch became decisively felt in this section and throughout all portions of Kasaragod Taluk in the present century. Large-scale thefts of timber from reserved lands and illicit kumri cultivation were extremely common until four or five years ago when forest reservation had perforce to be seriously urged and preliminary enquiries made. The moral of past neglect to make provision for reserved forest in this taluk is painfully obvious in a perambulation of the tracts submitted very recently for notification under sections 4 and 16.

47. *Sircar kumri,* 1900–17.—Owing to the rapid depletion of unreserved land and wargs, distress was considerably felt among the Mahrattis in the neighbourhood of Adur, Mandekole and Aletti reserves. Plots for kumri were again allowed about the year 1899 under departmental control in order to relieve distress. These operations are dealt with more fully in Chapter V.

Section 9.—Concessions.

48. Besides the rights allowed at the time of forest settlement which have been recorded in the District Forest office, the following are allowed within reserved forest :—

(i) Permission is almost invariably given to applicants for the opening of a road through reserve, on nominal rent.

(ii) Water from running streams or springs is permitted to be taken by channels to adjoining fields on application by ryots and on payment of a nominal annual rent.

(iii) Certain general concessions were granted by the Chief Conservator of Forests in the year 1924 in his Proceedings No. 2195/24–2, dated 3rd July.

49. The last-named were temporary and permissive in the first place for one year, but have been renewed each year subsequently up to the present time. Their object was to provide facility to cultivators for the collection of leaf-manure and dead fuel from reserved forests for the improvement of crops. They were as follows :—

(*a*) the clearance of undergrowth (shrubs and bushes of unclassified species) to a distance of half a mile from the limits of private holdings in all reserves except Muliyar, Kalanjimale and Veerakamba reserves ;

(*b*) the clearing of undergrowth in Muliyar, Kalanjimale and Veerakamba reserves (under fuel working) to a distance of 200 yards from the limits of private holdings ;

(*c*) clearing of undergrowth in all reserves sown with *Hopea parviflora,* viz., Parappa, portions of Porkala and Padnur and Jalsur East reserves ;

(*d*) free removal of green manure leaves of unreserved and unclassified species, dry leaves of all species, and dead fuel ;

(*e*) refund of half the grazing revenue in reserves where the Forest Village System had been introduced only if the reserves had not been burnt during the year or, in the case of accidental fire, if the fire had been extinguished without delay, and if illicit fellings had not taken place ;

" Undergrowth " was defined as growth not above 6 feet in height and dead fuel as the parts of a dead tree not more than 3 inches in diameter. The above concessions

were limited to the use of such produce within the village limits from which it was taken, and were subject to annual report and revision or total withdrawal if they became abused. The concessions have in nearly all cases been taken advantage of in localities where cultivation is extensive. Gross abuse has hardly been flagrant or universal, but limited to a few areas. In principle no definite line can be fairly drawn, however, since in instances where no abuse is noticeable, the people still have adequate resources outside the reserves and nearer to their homes, whereas where abuse has been noticed, it is generally apparent that other resources are scarce. Manure-leaf removal has been permitted in all coastal reserves (under certain restrictions) since 1902, and doubtless it occurred with, or without, official sanction at all times. For some years however, District Forest Officers did make an effort to put a stop to manure-leaf removal by refusal to issue permits. Government, when considering the general policy of manure-leaf removal from Presidency forests in the year 1921, exempted South Kanara from the regulations and restrictions imposed by their pronouncement, owing to the "luxuriousness of growth" (sic), which was supposed typical of the whole district, although this definition is decidedly euphemistic of the general condition of the coastal regions, especially in Kasaragod Range. The greater freedom afforded to villagers by the free removals permitted since 1924 has, in short, been availed of but little more than formerly in the more afforested regions wherein we had little or no objection and might even have welcomed such removals, and on the other hand has had detrimental effect on the poorer type of fuel and deciduous forest where soil preservation was most needed. Villagers prefer the broader-leaved species which again are those most common in coastal and deciduous forests. Abuse of the privileges has been most marked in the following reserves—Adur, Kanakamajulu, Anegundi, Jalsur West, Mandekole, Balpa and extension, parts of Mujur adjoining enclosures, and Dharmastala-Mundaje. Owing to the damage done under the above concessions (but principally that done in North Mangalore Division), it was recommended to Government that they be withdrawn at the end of June 1930, but the recommendation was not given effect to.

50. On the grounds of public health, the Chief Conservator has recently sanctioned general permission for the owner or occupier of a permanent or semi-permanent house not more than one furlong from a reserved forest to cut and remove (but not burn) all growth in the reserve within one furlong from his house, utilizing the produce for his own domestic and agricultural purposes, with the proviso that the Department might claim for disposal any timber tree cut, and should decide before utilization by the house-holder whether or not the tree was required for departmental use.

51. The Government as a tentative measure have permitted the villagers of South Kanara to hunt the below-mentioned animals in reserved forests after obtaining the previous permission of the Revenue Divisional Officers :—(i) pig, (ii) tiger, (iii) panther, (iv) bear. In addition, the Chief Conservator has permitted persons in possession of an Arms Act licence, to sit up in a reserved forest for the purpose of shooting a tiger or panther suspected to be hiding in the vicinity after killing cattle in or near the reserve, without the necessity for giving previous intimation but subject to report being made of having done so.

52. *Forest village panchayats.*—The feasibility of forming village panchayats for the more effective protection of reserves against fire and other damage, in return for certain concessions was first advanced by Mr. Longrigg about 1917. Two panchayats were formed in 1922–23, one for Balleri reserve and one for Porkala. Owing to the unsatisfactory working of the Balleri Panchayat it was dissolved under orders of the Chief Conservator in October 1928. The Porkala Panchayat has worked moderately satisfactorily but not with outstanding enthusiasm on the part of the panchayatdars, and it is doubtful whether this will continue for much longer. The villagers are not sufficiently interested in forest protection, nor are they so dependent on departmental interests as to find it worth while accepting responsibilities on its behalf. It is therefore unlikely that the system will be extended to other reserves in the immediate future.

53. *Assignment of lands for cultivation.*—In 1921 it was moved in the Madras Legislative Council that the culturable lands within reserved forests should be assigned for cultivation. While this could not be acceded to "*in toto*", it was ordered that such swamps as were unfit for timber-growth in the neighbourhood of ghat regions be selected and surveyed for assignment to "*bona fide*" applicants on darkhast. Sixteen plots of total area 327·35 acres were chosen, demarcated and reported fit for disforestation. Eight plots of 160 acres total extent were disforested in G.O. Mis. No. 1818, Development, dated 18th December 1925. The remaining 8 bits of 167·35 acres were admitted as enclosures. They were in the following reserves, viz., Kilarmale, Kiribag, Subrahmania, Kombar, Shiradi-Sisla, Miyar. The plots were handed over to the Revenue Department for assignment to labouring classes with the object of improving the labour supply in those remoter areas. It was ordered in 1928 that fresh applications for land should not be considered until those

disforested had been actually assigned ; lands in the plains regions were not considered advisable to disforest. A further question arose in 1928 with regard to forest land fit for " bagayat ", i.e., for gardens and topes of jack, mango, coconut, areca and other similar produce. Localities of this nature inside reserves are undoubtedly numerous and several very flourishing enclosures given over chiefly to this class of cultivation already exist in the hands of Brahman landowners. These are generally in protected valleys intercepting a perennial source of water-supply. In opening up a large self-contained block of considerable acreage, there might be some advantage to the department in assigning suitable localities for this purpose on payment by the assignee of the value of the tree-growth thereon, since the owners of areca or other topes generally require to construct a road for the export of their produce, such having been the case in Bantamale and Sampaje reserves. However, no pressing demand for land in remote tracts has been manifested hitherto, largely owing to the depredations of elephants and other fauna, there being indeed many cases of abandoned cultivation and enclosures in such tracts. The extension of bagayat lands within easily accessible limits around the fringes of forest blocks on the grounds of protection, is however open to objection. The present year has seen such a notable decline in world-prices of all raw material from the West Coast that this question is not likely to re-arise in the near future.

CHAPTER II.—THE FOREST.

SECTION 1.—COMPOSITION AND CONSTITUTION OF THE CROP.

I.—The Flora in general : Vegetational " Types."

54. It is impossible to obtain an adequate conception of the flora of the district as a whole, without giving very early and somewhat detailed attention to the principal types or associations met with. Ability to recognize the various types and their reactions to treatment is of prime importance. The subject from its ecological aspect is therefore examined in this chapter. The matter is, however, complicated by the multiplicity of species encountered, their often wide ranges of adaptation, and the numerous " accidents " to the crop, which have modified the environmental factors to differing extents. The present existing vegetation on any particular site is the result of a complex of such contributing factors, and observation shows that in the majority of cases the type to be found is of a transient order, although sometimes maintained indefinitely in its present stage by the treatment to which it continues to be subjected. The natural tendency of the vegetation is almost inevitably to shift by stages nearer to an evergreen climax formation, a process favoured by climatic conditions and becoming accelerated in the later stages. It is justifiable to assume that the original state of the forests in South Kanara must have been very largely if not entirely evergreen. Yet it would be rash to assert any very definite or invariable order of succession in the present natural gradations of type. While, for instance the present scrub jungles to be found in coastal fuel reserves have no doubt resulted from repeated fellings of deciduous jungle, and the deciduous forests themselves, which now occupy so extensive an area, appear undoubtedly to have been greatly stimulated by the old system of shifting cultivation in once evergreen forest, it is very doubtful whether the converse process of recovery is always the case. There is evidence to show that an evergreen association may come in at a very early stage in the recovery. As examples of this " short-circuit " phenomenon, entirely denuded areas at no great distance from river-banks but yet well above them, are sometimes becoming re-stocked largely by *Hopea Wightiana* ; fuel-coupes of 10 or 15 years ago have in some places acquired a heavy evergreen undergrowth, while areas under grass, formerly fireswept ridges adjacent to evergreen forest, are making a direct transition from grass to *Hopea parviflora* thicket (e.g., in Bantamale reserve).

55. Abnormal disturbance to the original crop has in places resulted in the occupation of the site by dominant or exclusive growth forms, e.g., Lantana, *Strobilanthes* and various species of *Gramineæ* which appear to resist further change for lengthy periods. These are not extensively met with, but are generally difficult to manipulate.

56. The proximity of extreme or widely variant types, and the frequent mergence of one type into another with every stage of transition is a feature of the district. The fact not only complicates stock-mapping but also sylvicultural procedure.

57. *Factors influencing " types."*—(*a*) *Climatic.*—The existing flora has adapted itself under a peculiarly favourable, even " forcing " climate, to a soil not intrinsically rich, but on the contrary, liable to become rapidly inimical to tree-growth after exposure to weathering influences, a process aided by the heavy rainfall. The prevailing evergreen type of ground-flora is evidently nature's means of soil protection.

(*b*) *External.*—The principal factor in the past was clear-felling for temporary cultivation. The richest forests of the ghats and foothills regions suffered most. Evergreen jungles were replaced, after one or two seasons' crop were removed, either by deciduous

species or by a type of evergreen much inferior to the original. Exposed southerly or westerly slopes were those most severely modified. Mild northerly slopes are often again covered by a mixed nondescript type containing both deciduous and soft-wooded ever-green species, frequently overrun by climbers, reeds, bamboo and rank herbaceous growth known locally as "kochi." Steep northerly slopes have often readily reverted to ever-green but rarely do they contain hardwood species of present value.

The protection afforded since reservation has not been sufficient to eliminate the occurrence of fire within the forest, but on the other hand it has undoubtedly induced in many localities a natural immunity from fire by promoting the growth of an evergreen ground-flora which is perpetually cool and moist. Localities vulnerable to fire, such as those adjoining cultivation and frequented footpaths, are generally a dry deciduous type, admixed with bamboo or reed. When fires are oft-repeated, the locality reaches finally the familiar open grassy appearance with scanty leaf cover and an abundance of xerophytic shrubs. Moist slopes with cool aspects are rarely burnt; casual fire may temporarily destroy the undergrowth, but the character of the locality is not seriously modified.

(c) *Results of Protection.*—Open maidans are gradually filled up with such adaptible species as *Anacardium occidentale, Strychnos Nux-vomica, Careya arborea, Phyllanthus emblica*, etc., together with a ground vegetation consisting generally of *Zizyphus* spp., *Calycopteris floribunda, Randia* spp., *Ixora coccinea, Holarrhena antidysenterica, Aporosa Lindleyana*, etc. The last-named although an evergreen tree is often an early arrival. *Terminalias* also quickly appear if elsewhere in the neighbourhood. In afforested regions fire protection has invariably aided the production of a herbaceous soil-covering becoming progressively evergreen. This is best seen in some of the oldest undisturbed reserves, such as Dharmastala-Mundaje. The consequent retention of moisture and reduction of temperature inside the forest enables the crop to acquire gradual self-immunity from fire, to considerable extent. The next stage in progression is in the appearance of large numbers of small evergreen tree species, viz., *Limonia acidissima, Aporosa Lindleyana, Actinodaphne Hookeri, Cinnamomum* spp., *Elacocarpus serratus*, etc., which form an understorey in the main canopy and considerably decrease the degree of direct sunlight at ground level. The stage has been reached in about 35 per cent of our deciduous forests, and is termed "Moist deciduous" in this Plan. It is a somewhat static stage, having both advantages and disadvantages. Humus soil is greatly added to. The fuller stocking is generally beneficial to soil conditions. Offensive forms of undergrowth are largely eliminated in course of time, giving place to the stocky, thick-leaved species such as *Webera canarica* and *Psychotria truncata*. On the other hand conditions are distinctly disadvantageous if a predominantly deciduous type of forest is desired in perpetuity, since natural regeneration of these species is gradually eliminated, and their reproduction by artificial means becomes hazardous and requiring constant attention. Protection has also threatened the elimination of thorny bamboo in many localities where it has now flowered and died, the seed no longer having opportunity to germinate except in favoured groups.

The natural sequence to a moist deciduous type is an invasion by evergreen tree species in the upper storey itself. The moist deciduous forest thus gives place to a sub-evergreen variety. Once conditions are favourable a space of 30–40 years would normally effect this transition. Apart from its deciduous species, the sub-evergreen forest in nature is rarely useful as a timber producer except in so far as *Artocarpus hirsuta, Mesua ferrea* or *Hopea parviflora* may here and there have succeeded as individuals or small groups in establishing themselves. This is generally a very fortuitous occurrence. At this stage conditions are permanently moist.

(d) *Physiographic factors.*—Changes of aspect are almost invariably accompanied by some perceptible modifications of vegetation. Where the change of aspect and slope is considerable, there is a correspondingly marked difference of type. A notable example is the difference between Devachalla and Bantamale reserves both contiguous but on opposite sides of a ridge running east and west. Similar marked differences appear in the types present in Bhagimale reserve on separate sides of valley, the one being open, poor deciduous type, the other showing dense evergreen. These examples could be multiplied. Steep evergreen slopes of northerly aspect are usually too dark to permit of widespread success of species such as *Hopea parviflora* and are usually covered by heavy shade-bearers. Hopea, *Mesua* and *Artocarpus* may however gain access on the ridges which bear greater light incidence. This perhaps led to the idea seemingly once advanced that a definite "zone" or "belt" of the abovenamed species was invariably to be found on ghat slopes. Or possibly this is because only the upper belts escaped the attention of kumri cultivators. It is necessary to remember this effect of aspect in considering the degree of opening up of canopy necessary in the case of *Hopea parviflora* regeneration. The upper elevations of the Western Ghats again produce a type of evergreen of true "shola" species quite distinct from those at lower elevations. These are for the most part outside South Kanara territory. Swampy regions also have their definite associations largely of those species having special adaptation of the root-system to allow of æration. Other factors, viz., proximity to the sea, etc., need not be discussed here.

58. *The distribution of vegetational types.*—A "type" stock-map of the district would show no separate and distinct "zones" of vegetation representative of any particular locality. The southern portions of Kasaragod Range are exceptional in that their more uniform history has permitted a greater levelling of the forest to one single type, namely, the grassy-scrub type. Elsewhere, all that need be said is that there is a preponderance of sub-evergreen and evergreen forests along the region of the ghats and foot hills. The entire series from grassy scrub to climax evergreen may be passed through if the route is chosen in travelling from the coast inland ; or the same experience may be had with less distance to travel in climbing upwards from the cultivation through pasture and "Kumaki" lands, through deciduous regrowth from old kumri on the lower slopes of hills and reserved forests, thence to the more inaccessible localities which having suffered little from disturbance, support evergreen formations, eventually out into stunted shola or grass. In some localities, private lands appear to have enjoyed a far greater measure of protection than adjoining areas belonging to the State. These low-lying hills bear heavy green foliage throughout the year in contrast to surrounding fire-burnt areas. The dividing line between virgin forest and regrowth from kumri is also usually well-defined.

II.—Analysis of Vegetational Types.

59. Below are mentioned those types which appear to be the principal and most evident. In the field they are found to contain several minor variations, and to merge one with the other in varying degrees of transition. The task of allotting a particular locality to one definite type-class during stock-mapping of the division has been difficult in consequence, at sevaral stages. The object of the stock-mapping has been practical rather than to prepare a technically correct survey of ecological types. The transition from evergreen to sub-evergreen is for example so frequent that the limits of each are most difficult to define ; the broad methods of treatment of each of those two types is moreover very similar. In consequence, no attempt has been made in the type-stock-maps to separate the two. Similarly, although attempts were made to indicate where *Xylia xylocarpa* regeneration was most abundant this species is present in appreciable number under a variety of different types and with several different classes of associates. The differentiation between "Dry-deciduous mixed forest" and "*Xylia* mixed forest" is undoubtedly real in many instances but not easy to make in others. A *Xylia* overwood is generally associated with the drier localities and fire-burnt ridges, but the best quality *Xylia* forest is associated with a distinctively evergreen undergrowth so that it might appropriately be termed "moist deciduous."

The following classification is therefore arbitrary and by no means final but suggestive for future ecological research. Species, are listed roughly in the order in which emphasis appears necessary. Many species are mentioned only in order to assist in a conception of the flora of the district, and are probably otherwise unessential.

60. *A. Scrub type.*—This type is found on laterite soils in the coastal belt region or on exposed waste places in inland localities degraded by kumri, annual fires, grazing or continued ill-usage. It is also found on grassy hill-tops with stunted deciduous species. The definition is a loose one and conditions are modified by soil and other factors. The type varies from an association of low scattered clumps of principally evergreen xerophytic shrubs with occasional tree species, to a considerably closer, more rank growth of mesophytic type containing herbaceous shrubs and thorny climbers. Three sub-types are shown below.

Sub-type (i) Dry scrub.—

Principal species : *Careya arborea, Phyllanthus emblica, Strychnos Nux-Vomica, Anacardium occidentale.*

Subsidiary species : *Mangifera indica, Erythrina indica, Ficus* spp., *Butea frondosa, Santalum album, Bredelia retusa,* etc.

Ground-flora : Grasses, *Ixora coccinea, Memecylon edule, Calycopteris floribunda, Randia Brandisii, R. dumetorum, Zizyphus* spp., *Mimosa pudica, Lantana aculeata, Eugenia corymbosa, Holarrhena antidysenterica, Aporosa Lindleyana, Sida rhombifolia, Cassia tora,* etc., (Sometimes *Hopea Wightiana*).

Sub-type (ii) Mesophytic scrub. Open maidans in proximity to high forest.—

Principal species ; *Terminalia paniculata, Terminalia tomentosa* (*crenulata*), *Phyllanthus emblica, Bambusa arundinacea, Macaranga Roxburghii, Careya arborea, Tabernæmontana Heyneana, Aporosa Lindleyana.*

Subsidiary species : Various Climbers abundant, viz., *Cæsalpinia mimosoides, C. Sappan, Abrus precatorius, Calycopteris floribunda, Zizyphus œnoplia, Zizyphus xylopyrus, Hybiscus furcatus, Mussænda frondosa, Jasminum angustifolium, Acacia pennata.*

Ground-flora : As in sub-type (1) with *Clerodendron infortunatum, Glycosmis pentaphylla,* etc. (*Melostoma malabarica, Webera canarica,* etc., in moist spots).

Sub-type (iii) Grassy hill-tops.—

Principal species :—*Careya arborea, Buchanania* (*angustifolia*), *Phyllanthus emblica, Wendlandia Notoniana, Eugenia* (*Wynaadensis*), *Melastoma malabarica, Flemingia strobilifera*, etc.

61. *B. Dry Deciduous.*—Generally regrowth from old kumri clearings, subject to fires, *Bambusa arnundinacea* is often present but rarely as a pure crop.

Sub-type (i) *Bambusa with mixed timber crop.*—On moderately deep soil and well drained slopes, also along river banks. *Tectona grandis* is occasionally present in the natural forest. The soil is either gneissic, with boulders and outcrops, or a heavy red loam becoming lateritized on exposure.—

Principal species : *Terminalia paniculata, Xylia xylocarpa, Dalbergia latifolia, Lagerstrœmia lanceolata, Pterocarpus Marsupium, Tectona grandis, Terminalia tomentosa Terminalia belerica, Dillenia pentagyna, Shorea talura* (sporadic groups only).

Ground flora : *Clerodendron infortunatum, Helicteris Isora, Glycosmis pentaphylla* (or *G. cochinchinensis*) *Holarrhena, Leea, Zizyphus, Dalbergia* spp., *Desmodium triquetrum, D. polycarpum, D. cephalotes, Flemingia strobilifera, Crotolaria verrucosa, Hybiscus furcatus,* etc.

Short grass general ; natural regeneration of *Xylia xylocarpa, Dalbergia latifolia, Pterocarpus Marsupium,* and *Terminalias* ; *Tectona grandis* in groups near parent trees in fire-burnt areas.

Sub-type (ii) : *Small bamboo with mixed deciduous forest.*—The small bamboo is generally *Oxytenanthera monostigma* (" Lenkiri ") or " Ame-watte " reed (insufficiently identified, but thought to be *Ochlandra Talboti Brandis* or possibly *Teinostachyum Wightii*). *Dendrocalamus strictus* is only very occasional. Soil is generally of poorer quality than subtype (i) being distinctly lateritic or shallow gneissic loam, rather rocky ; susceptible to fires.

Tree species are similar to sub-type (i), but teak absent, and *Xylia* more abundant. The crop is often sparse and regeneration poor, especially under " Ame-watte " reed which throws heavy shade and covers the soil with a thick matting of leaves.

Sub-type (iii) : *Mixed dry deciduous timber.*—Generally on red loam or gravelly laterite soil. *Terminalias* are the predominant crop, with *Xylia* admixture. Other species may be *Bombax malabaricum, Albizzia* spp., *Scheleichera trijuga, Adina cordifolia, Sterculia* spp., *Lagerstrœmia lanceolata*, etc. Undergrowth variable but generally similar to sub-type (i).

62. *C. Xylia mixed forest.*—*Xylia xylocarpa* is predominant in the overwood and generally present in various younger stages. It tends to constitute an almost pure crop on tops of ridges. Two quality-classes are discernable : on shallow or gravelly laterite soil and subject to fires it constitutes a second-quality class, with conditions of undergrowth similar in general to the dry deciduous type ; on deeper non-laterite soil it reaches first quality, often combined with a transitional or evergreen type of undergrowth. The principal associated species is *Terminalia paniculata.*

63. *D. Moist deciduous type.*—This type occupies moister, low-lying or undisturbed localities. The crop in the upper canopy is deciduous, generally from old kumri-fellings. It is characterised by a more or less well-developed middle storey of small evergreen type of undergrowth. Regeneration of deciduous species is sparse, almost absent ; *Xylia xylocarpa* however may be present, but it is generally in suppressed condition.

Principal species : *Terminalia tomentosa,* (*crenulata*), is characteristic, often also *Lagerstrœmia lanceolata, Terminalia paniculata, Xylia xylocarpa.*

Accessory species : *Odina Wodier, Olea dioica, Artocarpus hirsuta, Zanthoxylum Rhetsa, Vitex altissima, Stephegyne parvifolia, Lagerstrœmia Flos Reginæ.*

Middle storey : *Aporosa Lindleyana, Limonia acidisimma, Actinodaphne Hookeri. Cinnamomum zeylanicum, Toddalia bilocularis.*

Ground-flora : *Webera canarica, W. lucens, Strobilanthes* spp., *Psychotria truncata, Leea sambucina, Memecylon malabaricum, Clerodendron infortunatum, Cæsalpinea Bonducella, Gymnostachyum febrifugum, Ophiorrhizza Mungos, Ixora polyantha* ; filicales, *Curcuma*, etc. Climbers are often numerous, of which *Pothos Scandens, Butea superba, Bauhinia Vahlii* are common.

Leeches are generally present for about five months in the year.

64. *E. Sub-evergreen type.*—This type is difficult to define. It covers various kinds of vegetation in mid-transition between moist deciduous and true evergreen. For purpose of classification, the frequent nondescript useless cane-brakes and heavy climbers with sparse tree-growth are also included herein, as they generally occupy moist valleys in typical sub-evergreen zones. In timbered areas, top canopy is occupied by both dediduous and evergreen trees. In addition there is usually one or more middle storeys.

Principal species : *Terminalia paniculata, Terminalia tomentosa* (*crenulata*), *Lagerstrœmia lanceolata, Holigarna Arnottiana, Lophopetalum wightianum, Mangifera indica, Machilus macrantha, Artocarpus hirsuta, Zanthoxylum Rhetsa, Eugenia Gardneri, Vitex altissima, Diospyros sylvatica, Odina wodier, Diospyros microphylla, Myristica* spp., *Hopea parviflora*, etc.

Subsidiary species : *Ixora parviflora Elæocarpus serratus, Spondias mangifera, Calicarpa lanata. Cinnamomum* spp., *Pterospermum rubiginosum, Mallotus phillipinensis, Chasalia curviflora, Dicspyros assimilis, Apama siliquosa*, etc.

Ground-flora : *Webera* spp., *Strobilanthes, Ixora polyantha*, filicales, etc.

Climbers are numerous, and include *Pothos scandens, Piper nigrum, Aspidopteris canarensis, Entada scandens*, but many unidentified.

65. *F. Grassy swamp.*—Extensive areas of grassy swamp do not exist, but plots of 5 to 20 acres are not uncommon. They are generally abandoned cultivations in the foothills and sub-ghat regions. A few trees, such as *Terminalia tomentosa* (*crenulata*), and *Lagerstrœmia Flos-Reginæ*, with some evergreen trees are found in these localities. Shrub species such as *Bryophyllum calycinum, Cassia alata*, may be present.

66. *G. The evergreen forests.*—These present several distinctive characteristics. The chief of these is the presence of numerous species of Malayan type, in the order of *Guttiferæ, Dipterocarpaceæ, Myristicæ, Sterculiaceæ, Lauraceæ, Euphorbiaceæ*, and others.

The vegetation is luxuriant and in several zones ; the topmost leaf canopy may be 100 to 130 feet above ground level. The heaviest evergreen forests approximate to true " selection " type, containing all stages of growth from seedling to maturity. The small evergreen shrubs typical of moist-deciduous and sub-evergreen types are sparse in mature untouched forests. Trees are generally buttressed at the foot but otherwise a clean cylindrical bole is characteristic. The bark is generally thin, often lichen-covered and supporting aroids, ferns and orchids. Reeds and small palms are a frequent obstruction to progress, especially near watercourses. Woody climbers are abundant where the canopy is disturbed. Leeches are an obtrusive feature for a considerable part of the year.

Associations of evergreen flora :—The multiplicity of species renders the predominance of any single species rare. Little is known at present regarding sub-types. There would seem but little selectiveness exercised by the majority in the matter of soil, provided that the biological conditions are suitable. Apart from a rich humus layer, the ghat regions proper are not habitats of exceptional soil-depth or fertility. The matter is further complicated in that probably only a small proportion of forest (chiefly that on the upper slopes and in more remote regions) is true virgin forest. The slopes of Bhagimale, Kombar, Kiribag, and Kilarmale have been largely kumried, or to some extent interfered with for the growing of cardamoms. Cleared or partially-cleared areas, even when again restocked by evergreen species have not the same characteristics of the original forests and there has been a retrogression in type, with a preponderance of the fast growing softwooded species where formerly hardwoods may have existed. The heaviest and darkest evergreen forests are therefore not necessarily true virgin jungle, but they nevertheless closely represent a true " climax " type. The comparatively valueless associations are unfortunately all too common.

The following is a purely arbitrary and not strictly scientific classification :—

Sub-type (i) *Heavy Evergreen.*—On slopes with northerly or easterly aspect. The associations met with are complex and each block possesses somewhat different, even unique characteristics, which may be purely fortuitous or at least are unaccountable for with our present knowledge of the subject. No definite order of preponderance or importance can therefore be allotted to the following list of species which is very imperfect and should not be applied to any particular locality as representative thereof.—

Principal species : *Dipterocarpus indicus, Diospyros assimilis, D. sylvatica, Calophyllum tomentosum, C. Wightianum, Vateria indica, Garcinia Cambogia, G. indica, Hardwickia pinnata, Myristica canarica. M. attenuata, Pterospermum rubiginosum, P. obtusifolium, Artocarpus Lakoocha, Caryota urens, Dysoxylum malabaricum, Mesua ferrea, Dichopsis elliptica, Mangifera indica, Picus callosus, Hemecyclia elata* ; less frequently *Hopea parviflora, Artocarpus hisuta, Litsœa Wightiana, Elæcarpus serratus, E. tuberculatus, Tetrameles nudiflora, Nothopegia travancorica, Eugenia argentia, Nephelium Longana, Acrocarpus fraxinifolius, Canarium strictum, Cedrela Toona, Terminalia travancoriensis.*

Middle storey and undergrowth : *Ixora nigricans, I. brachiata, Aporosa Lindleyana, Flacourtia montana, Baccaurea coutallensis, Colebrookia oppositifolia, Jambosa læta, Mallotus muricatus, Symplocos* spp. Grasses (e.g. *Hypolyatum, Corex* Spp.) *Rauwolfia serpentina, Cinnamomum* spp., reeds, palms and ferns in abundance. The cardamom, *Elettaria cardamomum* is often cultivated.

Sub-type (ii) *Swamp evergreen.*—In low-lying badly drained localities *Myristica* species are often gregarious owing to specially adapted root-system along with *Lophopetalum Wightianum, Holigarna Arnottiana*, the wild *Areca* palm, clumps of *Ochlandra*

reed, the screw-pine *Pandanus canarensis, Curcuma* and frequently dense cane-brakes of *Calamus Thawaitesii* and *C. rotang.*

Sub-type (iii). *Riverain evergreen.*—River-banks have generally a typical flora, of which the following are associates :—

Vateria indica, Hopea Wightiana, H. parviflora, Myristica spp., *Holigarna Arnottiana, Eugenia macropcarpă, Memecylon angustofolium, Polyalthia Korinthii, Humbolatia Brunonis, Elæcocarpus serratus, Heynea trijuga, Roxb., Nauclea Missionis, Lophopetalum Wightianum, Alstonia scholaris, Romonia riparis.*

Sub-type (iv), *Hopea parviflora high-level associates.*—*Hopea parviflora* emerges in the ghat zones proper at the tops of the spurs and ridges between 700 and 1,500 feet elevation where it tends to gregariousness ; but in kumried areas at the foot of slopes especially with westerly or southerly aspect much young regeneration in seedling and sapling stages is now appearing which would greatly benefit by artificial assistance.

Some of the tree associates with it are :—*Mesua ferrea, Calophyllum tomentosum, Eugenia argentia, Eugenia Gardneri.*

Sub-type (v). *Hopea parviflora low-level associates.*—*Hopea parviflora* again tends to become a dominant species in moist localities of the foothills, and riverain areas in gently undulating country. It adjoins and often tends to invade moist deciduous forests and the associations found therewith approximate very closely with sub-evergreen flora.

The principal species in this " type " are *Eugenia Gardneri, Artocarpus hirsuta, Calophyllum tomentosum, Pterospermum rubiginosum, Lophopetalum Wightianum, Cinnamomum* spp., *Mallotus phillipinensis, Mangifera indica, Diospyros microphylla, Vateria indica, Aporosa Lindleyana, Lagerstrœmia lanceolata, Terminalia tomentosa* (*crenulata*), *Ficus* spp., *Actinodophne Hookeri, Pithecolobium, Ochlandra* reed, etc., The undergrowth is very variable, but usually contains *Webera* spp., *Psychotria truncata, Limonia acidissima, Clerodendron, Leea* and *Ixora* spp.

66-A. *Statement showing areas of vegetational types.*—

Serial number. (1)	Name of Reserved forest. (2)	Area. (3)	Dry deciduous (4)	Dry deciduous Xylia preponderating. (5)	Moist deciduous. (6)	Evergreens and sub-evergreens. Hopea absent. (7)	Evergreens and sub-evergreens. Hopea present. (8)	Bamboo cum timber. (9)	Bamboo. (10)	Degraded timber. (11)	Scrub. (12)	Swamp. (13)	Grass and rock. (14)	Worked for fuel. Felled. (15)	Worked for fuel. Proposed. (16)	Under plantations. Hopea. (17)	Under plantations. Teak. (18)	Unstock-mapped. (19)	Remarks. (20)
		ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	
	KASARAGOD RANGE.																		
1	* Pumale	4,763	..	..	..	..	32	..	1,168	3,563	..	..	..	..	..	..	..	..	
2	Sampaje and extension	11,851	1,520	3,884	32	208	43	454	2,866	..	333	13	40	..	..	..	..	2,484	
3	Todikana	3,001	45	1,065	99	..	18	..	1,752	..	22	..	..	..	..	..	25·3 *	..	
4	Adur	4,939	..	..	..	..	38	..	..	4,277·5	..	..	..	..	..	..	225	..	
5	Aletti West ..	2,879	1,075	727	452	205	130	18	..	..	47	..	..	..	..	..	73	..	
6	Aletti, East ..	5,748	3,919	627	364	..	137	..	628	..	..	..	..	..	..	..	..	..	
7	Bantaje	2,246	..	..	..	..	..	..	..	2,246	..	..	..	..	..	..	..	..	
8	Kanakamajalu ..	1,952	..	458	1,193	..	88	..	134	..	79	..	..	..	..	..	..	..	
9	Kannadka	1,305	..	..	..	..	..	..	..	1,305	..	..	..	..	..	..	..	..	
10	Karadka	2,920	..	..	..	..	..	..	..	1,334	160	..	..	..	1,426	..	..	..	
11	Muliyar	1,999	..	..	..	..	..	..	..	224	661	..	..	1,050	64	..	21 *	..	
12	Mandakolu ..	5,315	3,148	586	676	234	50	..	..	..	524	9	67	..	..	..	..	..	
13	Medinadka, East ..	544	..	85	219	6	..	..	..	..	234	..	..	..	..	..	97 *	..	
14	Medinadka, West ..	2,392	993	..	419	13	..	..	..	..	870	..	..	..	..	..	..	..	
15	Parappa and extension.	2,285	..	..	..	..	87	..	..	..	..	7	..	..	..	2,129	62	..	
	Total ..	..	10,700	7,432	3,454	666	623	472	6,548	12,949·5	2,930	29	107	1,050	1,490	2,129	501·5	2,484	

* Kumried plots.

Serial number. (1)	Name of Reserved forest. (2)	Area. (3)	Dry deciduous (4)	Dry deciduous Xylia preponderating. (5)	Moist deciduous. (6)	Evergreens and sub-evergreens. Hopea absent. (7)	Evergreens and sub-evergreens. Hopea present. (8)	Bamboo cum timber. (9)	Bamboo. (10)	Degraded timber. (11)	Scrub. (12)	Swamp. (13)	Grass and rock. (14)	Worked for fuel. Felled. (15)	Worked for fuel. Proposed. (16)	Under plantations. Hopea. (17)	Under plantations. Teak. (18)	Unstock-mapped. (19)	Remarks. (20)
	UPPINANGADY RANGE.																		
1	Charmadi Kanapadi	13,988	..	1,727	1,227	..	..	..	265	..	19	..	821	..	..	..	..	9,929	
2	Dharmastala Mundaje and extension	6,336	155	2,900	2,405	157	178	..	..	..	541	..	..	..	..	..	..	..	
3	Dondalarabi ..	992	..	..	..	..	..	..	..	992	..	..	..	..	..	..	..	..	
4	Dadantamale ..	2,378	..	466	1,302	..	28	..	..	..	550	32	..	..	..	..	..	..	
5	Miyar	14,691	..	2,583	2,168	140	..	..	177	..	..	99	70	..	..	..	..	9,454	
6	Mundajikap ..	476	..	42	..	..	..	..	..	..	44	..	..	..	..	390	..	..	
7	Nidle	2,704	..	1,489	623	114	..	..	28	..	450	..	..	..	..	..	..	..	
8	Bhagimale	13,579	2,199	..	..	4,262	131	432	..	..	40	..	120	..	..	..	..	2,411	
9	Kidu	..	..	1,734	514	767	325	90	142	..	202	10	..	..	..	..	..	..	
10	Kodambilla ..	1,611	..	363	757	183	8	..	22	..	274	4	..	..	..	..	..	..	
11	Konaje	6,486	1,854	2,214	1,042	162	..	..	51	..	1,163	..	..	..	..	..	..	..	
12	Kunthur and extension	4,084	..	1,445	1,436	75	14	..	322	..	792	..	..	..	..	..	..	..	
13	Mujur	10,792	..	5,107	4,521	318	200	..	144	..	438	64	..	..	..	..	..	..	
14	Nerankimale ..	3,518	..	..	..	..	..	..	..	2,539	..	..	..	506	473	..	..	..	
15	Padnur	3,988	1,374	134	893	..	..	..	54	..	861	..	..	..	..	672	..	..	
16	Porkala	4,557	1,427	397	1,556	..	..	..	32	..	387	..	..	..	..	758	..	..	
17	Swarmale	1,449	..	..	..	..	..	..	..	1,449	..	..	..	..	..	..	..	..	
18	Shiradi Sisle and extension. ..	24,318	..	2,728	959	713	14	..	18	..	143	179	350	..	..	..	..	19,214	
19	Shibaji	3,262	..	669	1,976	129	38	..	146	..	275	29	..	..	..	..	..	..	
20	Kombar	11,687	..	2,064	1,645	720	16	..	163	..	346	..	..	..	..	..	..	6,733	
	Total ..	..	7,009	26,062	23,024	7,740	952	522	1,564	4,980	6,525	417	1,361	506	473	1,820	..	47,741	

Serial number.	Name of Reserved forest.	Area.	Dry deciduous.	Dry deciduous Xylia preponderating.	Moist deciduous.	Evergreens and sub-evergreens. Hopea absent.	Evergreens and sub-evergreens. Hopea present.	Bamboo cum timber.	Bamboo.	Degraded timber.	Scrub.	Swamp.	Grass and rock.	Worked for fuel. Felled.	Worked for fuel. Proposed.	Under Plantations. Hopea.	Under Plantations. Teak.	Unstock-mapped.	Remarks.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
		ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	ACRES.	
	PUTTUR RANGE.																		
1	Narimogaru ..	1,520	..	..	..	..	..	..	..	640	..	..	..	330	550	..	..	..	
2	Aivaranad	1,578	..	..	..	..	..	..	..	1,578	..	..	..	..	..	..	..	..	
3	Bantamale	2,604	..	392	380	480	566	..	700	..	74	12	..	..	..	..	..	..	
4	Balpa and Extension	3,599	..	632	140	724	139	..	456	1,493	5	10	..	..	..	..	..	..	
5	Bellare	658	..	..	..	..	..	..	..	658	..	..	..	..	..	..	..	..	
6	Dolpadi	953	..	..	..	..	30	..	..	923	..	..	..	..	..	..	..	..	
7	Kalanjimale ..	2,712	..	..	..	..	..	..	..	1,491	..	..	..	211	1,010	..	..	..	
8	Kilarmale	13,215	909	..	573	320	3,699	1,638	330	..	109	..	890	..	..	..	..	4,747	
9	Kallapattamale ..	1,077	..	..	..	..	63	..	..	1,014	..	..	..	..	..	..	..	..	
10	Kaniyarmale ..	3,132	..	940	863	..	17	..	23	..	1,289	..	..	..	..	..	..	..	
11	Kiribag	9,797	1,133	..	813	2,449	2,492	..	2,864	..	..	46	..	..	..	..	..	..	
12	Nalkur	5,925	129	705	2,080	581	1,654	314	187	..	259	16	..	..	..	..	..	..	
13	Paikadmale ..	1,403	..	..	..	..	16	..	..	1,387	..	..	..	..	..	..	..	..	
14	Subrahmanya ..	7,537	759	..	470	910	1,776	..	1,051	..	680	..	..	..	..	..	..	1,891	
15	Virakhamba ..	1,537	..	..	..	..	..	..	..	1,537	..	..	..	..	..	..	..	..	
16	Yenakkal	3,428	..	1,398	266	730	510	..	483	..	25	16	..	..	..	..	..	..	
17	Yenamuru	2,927	94	948	1,462	..	84	..	..	..	312	27	..	..	..	..	..	..	
18	Jalsur East.. ..	784	..	50	218	..	141	27	..	..	7	..	10	..	..	331	..	..	
19	Jalsur West ..	2,189	..	1,318	422	..	..	..	256	..	172	..	21	..	..	..	..	..	
20	Anegundi	3,247	..	1,147	783	..	28	284	807	..	198	..	..	..	..	..		..	
21	Aranthakallu ..	991	..	112	220	65	320	..	..	..	274	..	..	..	..	..	..		
22	Devachalla ..	3,184	..	383	533	61	800	904	208	..	295	..	..	..	..	..		..	
	Total ..	73,997	3,024	8,025	9,223	6,320	12,335	3,167	7,365	10,721	3,699	127	921	541	1,560	331	..	6 638	

67. *" Types " as indicators of soil quality.*—The " types " classified in the foregoing paragraphs are no true guide, so far as is known, to corresponding " quality-classes " of soil. They represent certain biological conditions, to which without doubt soil factors largely contribute, but precise knowledge is entirely lacking. An endeavour was made by the writer during inspections to ascertain relationships, if any exist, between different kinds of soil and sub-strata with corresponding vegetation. To this end the results of the soil-survey may be of importance, and it is desirable that the Provincial Sylviculturist should be made cognisant therewith. Without very detailed analyses both of soil and vegetation however, no safe conclusions may be drawn. The subject is much confused by disturbances to vegetation by external agencies, so that local flora are often only partially adjusted to the site. No true or reliable guide to soil-quality in relation to its timber-bearing capacity could be observed from the ground flora alone. Certain species of evergreen undergrowth, while almost invariably present on deep fertile soils, appear to be no sure index in *themselves* of soil depth. Similarly, the fact that a certain locality supports a poor stunted crop of deciduous species is no criterion that evergreen crops would be of similar habit in that identical soil. Much obscurity likewise surrounds the problem of teak soils, for the few localities in which that species is found growing naturally are certainly neither the richest nor deepest in the district. Some information upon this last point may be obtained during the period of this plan if the intentions described in Chapter IV of Part II are carried out.

68. *General conditions of the forest.*—The great majority of the tract dealt with is under mixed, irregular, natural forest. The plantations are separately dealt with in Chapter III and call for no special comment.

The general quality of the forests of South Kanara as a whole, cannot be said to compare favourably with the more valuable crops of Malabar, Wynaad, or South Coimbatore Divisions. Potentially however, they allow scope for immense appreciation in value, and there would appear small reason why they should not in course of time be second to very few in the Madras Presidency. The present depreciated value is ascribable chiefly to the following circumstances, some remediable, others difficult to circumvent :—

(1) Conditions of settlement, involving complex boundaries, numerous enclosures and forest " Kumaki " rights, which render large areas vulnerable to fire and difficult to protect.

(2) Impoverished soil conditions resulting from " kumri " cultivation. Reserves are confined largely to hills and rocky slopes where soil is not deep.

(3) Inadequate replacement of useful species under past systems of working, particularly the " Permit " system by which considerable stocks of the most valuable species, e.g., teak and rosewood were reported to have been cut. Under the 1902 Working Plan, very inadequate provision was made for the regeneration of useful species and no artificial regeneration was effected.

(4) The tendency for climbers and useless vegetation to take possession of the cleared areas, especially in moist localities. A heavy thicket of miscellaneous herbaceous growth inhibits regeneration of tree species for an indefinite period. Although considerable areas of teak " kumri " were made in Kasaragod Range during the early years of the present century, little or no subsequent attention was given them, and that species survives in only a comparatively few favoured patches.

(5) The bulk of the forests are still immature owing to recent settlement. This is more particuarly the case in the deciduous zones. There are computed to be about 4,000 acres of deciduous forest containing a reasonable proportion of exploitable-sized timber. The former process of " kumri " imparted a certain even-aged " quality to the timber regrowth. The average age of immature natural crops is estimated to fall between 30 and 40 years.

69. *The deciduous forests.*—Stocking is on the average good. It is thin or poor in areas vulnerable to fire and theft, and where bamboos have taken possession of the site. Pole crops are usually very complete. The interior of some blocks, e.g., Mujur, is very open around old enclosures where the forest was repeatedly fired by ryots as protection against elephants and wild beasts.

A tendency to evenness of age is apparent in the younger crops, but the older woods bear a partial resemblance to the " selection " type containing pole and sapling crops. In *Xylia* forest, regeneration is often prolific under canopy. Where subject to ground fires, however, sapling crops are often notably absent ; regeneration comes up year by year and is burnt back. In moist forest sapling crops are considerably suppressed by a middle canopy of evergreen trees.

70. *The sub-evergreen and evergreen forests.*—The site is often fully occupied but the proportion of utilisable material is generally very small. The " Hopea forests " of Jalsur

East and Nalkur reserves are exceptional. These are at moderately low-levels and closely adjoin sub-evergreen and moist deciduous forests. They contained a comparatively heavy stand per acre. The average yield of utilisable material from Jalsur East Reserved Forest was about 450 cubit feet per acre. From Nalkur compartment I the yield averaged 90 cubic feet per acre. The quantity of non-utilisable timber, especially of *Eugenia Gardneri*, would probably be about 400 to 700 cubic feet. The yield of utilisable material from the higher-level evergreen forest of Aletti West (1928–29 coupe) was, however, 590 cubic feet per acre, of which 404 cubic feet was Hopea.

If *Hopea parviflora* were grown to maturity in an almost pure stand, the yield should be in the neighbourhood of 1,200 cubic feet per acre, on good quality soil. The far superior growth and fast-growing capacities of evergreen crops carry weight in favour of their introduction and cultivation wherever these species will readily become established. It is fortunate that the desirable hardwoods, viz., *Hopea parviflora, Mesua ferrea, Artocarpus hirsuta,* are often close associates in nature, although *Mesua* is rarely seen at low levels. The readily accessible crops carrying exploitable material have already been felled and regenerated.

A few riverain strips remain but we must turn to higher levels for future coupes. The occurrence of pole-stages is greater at the higher levels (viz., Bantamale Reserved Forest) than in previous coupes, there being less tendency to segregation of ages, and crops are not uniformly mature and overmature. A. considerable area exists under varying degrees of density of natural seedling and sapling stages of Hopea. With due attention, considerable areas of comparatively useless crops can be converted into high-grade property in a measurable period of time. These areas exist along riverain belts or as occasional nuclei in moist deciduous forests, in irregular patches disposed along the foot of ghat-slopes and adjoining tracts, also spreading downwards from the evergreen belt, to lower levels. In general, there is a tendency for *Hopea parviflora* to spread from higher to lower levels and from true evergreen to moist deciduous and *Xylia* forest. *Mesua* and *Artocarpus* are far less numerous in the district and there is noticeably less tendency for gregarious location of these species. *Mesua* remains almost entirely a high-level species. It is nowhere found growing to very high girth at present, the majority being between 5 feet and 7 feet above buttresses. Its location is generally with the heavier evergreens, but disposed along ridges, in Bantamale, Bhagimale, Kiribag, Kombar, and Kilarmale reserves. With the exception of the first named reserve, mature crops are for the most part found only in small groups in otherwise unexploitable forest and somewhat difficult and inaccessible localities. It is worthy of note that in Bantamale reserve Hopea is confined to the western half of the ridge, and *Mesua* to the eastern half under slightly shadier conditions ; the two species intermingle only slightly.

Artocarpus hirsuta is found disposed singly or in small dispersed groups chiefly in Hopea low-level associations or sub-evergreen types with tendency to spread into moist deciduous forest. It occurs sporadically among heavy evergreens. An almost pure group of saplings and young poles of this species has been raised successfully from natural seed-fall in Jalsur East reserve. *Dichopsis elliptica* is known to occur only in Bantamale reserve in any quantity. *Hardwicka pinnata* and *Dipterocarpus indicus* are typical as a rule of the denser evergreen forests at higher elevations.

71. *Notes on individual species.*—The following notes are added on the various species commonly met with.

72. *Tectona grandis.*—From old reports and notes it would appear that this species was found once over a larger area than now-a-days. The strip of country now under agricultural crops between Parappa and Sampaje reserves contained numerous teak poles and saplings. The forests of Malloth (now proposed for reservation), Todikan, Sampaje, Nerankimale and Parappa contain indigenous teak of second or third quality. In Sampaje it occurs not only at lower levels but along ridges and steep slopes. Other localities wherein found, of which no records of plantations exist, are small patches of a few acres extent in Yenmuru, Adur and Dharmastala reserves. It is significant that this species occurs almost exclusively along that strip of country bordering the trunk road from Mercara to Mangalore and Kasaragod formerly much used by Mahratti tribes and others, and severely kumried and burnt. In most cases it is also associated with bamboo (*Bambusa arundinacea*). The best quality teak is found in Sampaje reserve, on non-lateritic soil of disintegrated gneiss or deep red clayey laterite. Natural seedlings are present on frequently burnt areas adjoining cultivation. The species is entirely absent in Kanale Todu valley of Sampaje reserve, which contains deep soil but is more completely protected by forest-clad ridges on three sides. The boles are straight-grown, comparatively unfluted and free from epicormic branches. Where unharmed by climbers or not hollowed out by fires, trees are very healthy. Mature individuals of good height and growth-habit are found even where there is hard surface laterite rock which must have appeared during the life of the tree itself. There is

some reason in the suggestion that the absence of teak in the forests of South Mangalore Division results from the impossibility for this species to survive along with the luxuriant vegetation which normally accompanies good deep soil ; and where fires and clearings have so greatly reduced competing vegetation that teak might succeed, the soil so rapidly becomes lateritized that it no longer affords a hospitable habitat for that species. Rich alluvial clay would probably resist this lateritizing process, but such deposits occur only in small pockets and occasional stretches of river-bank, the drainage along the upper reaches of streams being normally too rapid to permit of such. The presence of teak on ridges and slopes of gneissic formation in Sampaje reserve is probably fortuitous, indicating that the tap-root has been able to penetrate through fissures in the broken and contorted strata, but this circumstance forms no reliable guide for the formation of regular plantations in these localities. Neither present observation nor past experience hold out great hopes of our being able to form extensive plantations of this species in South Kanara, but there would appear no reason why it could not be quite successfully introduced in selected small localities, especially in the proximity of stream banks and along the lower contours of hill-slopes.

73. *Dalbergia latifolia,* " Biti " (Kan.).—This species is admirably suited to many parts of the district. It is a natural associate with teak in Sampaje and Parappa. In Coorg territory above Sampaje, remarkable success has been attained in the production of a pure kumri of this species. Its growth is comparatively rapid, and old reports speak of this species having attained to superior dimensions and excellent habit. The Working Plan of 1902 reserved this species with the object of allowing some recovery after intensive fellings by Mangalore merchants. It was formerly spoken of in the Subramania forests (where it is now scarce). It is well known to be adaptible to lateritic soil conditions, provided not too advanced. In a part of Adur forest it has become a major species of a somewhat stunted crop on a plateau of laterite rock. It seems to prefer deep soil of the sub-ghat regions under dry deciduous conditions.

After *Xylia xylocarpa* it is probably the most successful species in regenerating itself naturally by root-sucker where other undergrowth is present. Root-suckers are produced abundantly after clear-felling, and are further stimulated by surface root-wounding and burning.

74. *Terminalia tomentosa* (*Crenulata*), " Banapu " (Kan.).—This species is incidental to both dry and moist deciduous conditions, but attains its best proportions in the latter. It is very suited to semi-lateritic soil. It attains to splendid size in sub-ghat terrains and valleys of the foothills. Somewhat " sappy " in the younger stages, the timber produces a high proportion of sound heartwood in the mature tree. In dry fire-burnt areas, the base is almost invariably unsound, but in protected moist localities the timber is uniformly sound at almost all sizes hitherto felled. A specimen of 14 feet girth in Mujur reserve still showed every appearance of being healthy. It is apt to develop " water-blister " about 10 feet from the ground. The outer bark is often scraped by villagers for the production of chunam. Natural reproduction of this species is often prolific by coppice and seed in open felled areas, but becomes completely lacking in typical moist conditions of soil and undergrowth.

75. *Terminalia paniculata,* " Marwa " (Kan.).—The most uniformly successful and well-distributed species in the District, it is common in all types from scrub jungle to sub-evergreen. It attains to excellent dimensions. Its general characteristics are closely akin to *Terminalia tomenstosa* (*Crenulata*). In parts of Sampaje reserve it amounts to nearly 50 per cent of the crop. It is unfortunately little in demand.

76. *Lagerstrœmia microcarpa,* " Benteak " or " Billinandi " (Kan.).—A close associate of the *Terminalias* in moist deciduous forests, and again in dry zones with teak and *Bambusa,* becoming sparse in *Xylia* forest. This species produces fine sound logs in Sampaje and Mujur reserves. It grows to considerable height with long straight stem. Regeneration of this species is sparse in natural forest but is stimulated by clear-felling and burning.

77. *Xylia xylocarpa,* " Tirwa " (Kan.).—Is the species " *par excellence* " adapted to ridges and upper slopes of the plains and foothills forests. It tends often to become a pure crop. It withstands fire more successfully than *Terminalia* crops. It rarely exceeds a girth of 7 feet at breast height. Up to 5 feet girth it is generally sound, when felled, but the refractory quality of the timber lends to subsequent splitting after conversion. On shallow laterite soil its somewhat twisted growth-habit is maintained, but on deep soil it is a tall handsome tree with straight cylindrical bole. It is not very quick to take possession of charred and burnt areas, but often makes a rapid and successful invasion a year or two later. It becomes quickly re-established if the burn was light, and may occupy the ground as a dense pure thicket. It is widely regenerated by root-sucker and seed. Ground fires frequently reduce regeneration to ground-level ; the following rains a fresh shoot appears.

from the root. This is a widespread condition in the young crops, which experience difficulty in acquiring immunity from ground fires by getting above them. The species is adaptible to considerable degree of shade in youth. Operations in the moist deciduous forests of Porkala and Padnur for the artificial regeneration of Hopea have clearly demonstrated that identical methods (although not necessarily as cautious) are to the advantage of *Xylia* regeneration which can completely restock an area under shelterwood.

78. *Bambusa Arundinacea,* "Biduru" (Kan.).—This species occurs principally in Kasaragod and Puttur Ranges. It is sparse in Uppinangady and Beltangady Ranges. Its occurrence is most marked on the southerly and westerly aspects of spurs and off-shoots from the principal ghat range (viz., Sampajé, Pumale, Kilarmale, Thodikan, Devachalla, and Aletti East reserves). It occurs along river banks but very rarely pure. The principal bamboo areas of Uppinangady Range are in Nerankimale and Porkala-Padnur reserves, these admixed with high proportion of timber species. It is present in most fuel coupes. Bamboo has flowered in all parts of the division during the last 14 years. It is still flowering at Sampaje. The extent to which it will succeed in reoccupation is uncertain. Bamboo seedlings are now meeting considerable competition in many localities as the result of protection against fire. The future distribution of bamboo is accordingly likely to be more limited than hitherto in almost all reserves. A scarcity of bamboos will probably continue to be felt in the southern parts of the district for the next 10 years.

The following years of bamboo flowering have been recorded for the West Coast of India :—

1804	West Coast	(Beddome).
1866	Malabar, South Kanara, Wynaad, Coorg.	(Beddome).
1874–84 .. (chiefly 1878)	Dharwar, Kanara, Belgaum ..	(Troup).
1905–18 .. chiefly 1912)	Dharwar, Kanara, Belgaum ..	(Troup).
1913–15 ..	Coorg	(Troup).

The above cases were noted as gregarious flowering. Recent flowering began about the year 1916–17 in South Mangalore Division. It was then reported to be flowering in sporadic isolated clumps, in Nalkur, Kiribag, Kilarmale and Bantamale reserves. Similar reports followed the next year for Veerakhamba, Kalanjimale, Narimogar and Paikadamale. By 1919 they were reported almost completely dead in Dondalarabi, Dadanthamale, Parappa and Kandadka. In 1919–20, 901,660 bamboos were sold in the division at Rs. 1–8–0 per 100 as they were seeding generally. Regeneration was said to be plentiful and by 1922-23 young clumps said to be about 5 years old had reached 15—20 feet in height in the neighbourhood of Subramanya and Kollamogaru. In Sampaje, Pumale and Thodikan reserves, clumps have been flowering here and there since 1925–26 ; it became general in 1928 and still continues. About 80 per cent on the lower slopes and river banks are now dead.

79. *Oxytenanthera monostigma,* "Lenkiri" (Kan.).—This species is now also flowering generally in the division.

80. *Hopea parviflora,* "Kiralbogi" (Kan.).—This species is ideally suited to South Kanara conditions. Formerly not in great demand, its use has become popularized both locally and generally along the West Coast, as well as with the Railway Companies as a sleeper-wood. The species is probably the only one intentionally cultivated for timber by private individuals in local "hadies," less however in this division than in North Mangalore. It is adaptible to both gneissic and lateritic soils, and reaches optimum conditions in deep ferruginous and not too heavy loam, from partially weathered gneiss in the foothills. It has wide distribution in elevation up to about 2,000 feet. Its occurrence is determined in the first place almost exclusively by the appropriateness of the surrounding vegetation. Limiting conditions of soil-moisture and light-incidence cannot be quantitatively ascertained ; these two factors interact on the growth of young seedlings for several years, but when pole-stage is reached, the species can withstand direct light up to complete exposure. Until an advanced stage, however, there is little doubt that partially diffused light is advantageous to growth provided there is vertical freedom from surrounding vegetation. River banks often provide ideal conditions of both soil and atmospheric humidity combined with the requisite degree of light. In general, the greater the humidity of the locality throughout the year, correspondingly more pronounced light-intensity is permissible and even beneficial to the established seedling. Limiting conditions in evergreen localities are invariably due to inadequacy of light, this species being not a heavy shade-bearer at any stage of its growth. It accordingly finds suitable habitat chiefly on upper slopes and ridges in the evergreen zone and in moist deciduous or semi-evergreen zones on the more gentle undulating slopes of the foothills. The heavy quantity of seed shed every few years, widely

scattered by wind agency, is probably due to the somewhat particular requirements of this species for successful germination. The seed contains little vitality and dies without it find quickly suitable germinating conditions. A gregarious tendency is also noticeable for the same reason. At the stage now reached by a very considerable extent of the forests after a period of recovery from external disturbance, the widespread establishment of young crops of Hopea is taking place under natural conditions. It is frequently noticeable that natural regeneration is markedly deficient under mature crops in evergreen slopes of shady aspect or along sheltered valleys, but at once becomes apparent in the surrounding forest wherever canopy becomes modified to admit the requisite degree of light, or aspect changes to similar effect. Thus wherever a belt or patch of mature timber exists on upper slopes, a tendency may almost invariably be seen for the species to spread to lower contours covered by kumri regrowth. Typical examples are found among the widely varying and generally valueless secondary flora of Subrahmania, Kiribag, Bantamale, Aletti East and West, and Sampaje reserves, and are clear indications of type-transition in actual progress. Although the initial requirements for germination and seedling growth are certainly peculiar and limited, the inter-play of environmental factors within those limits appears to afford surprising scope. Thus *Hopea parviflora* has established itself under *Ochlandra* reed, in open grassy maidans, in typical moist-deciduous forest, in *Xylia* forest without the shelter of a middle-storey, in moist reverain belts, and in sparsely-stocked deciduous or scrub areas. From none of these individual instances would it be at all wise to draw general conclusions for the purpose of extensive practice. The only wise course is to ensure that safe average known conditions of humidity and light are available, a fact usually indicated by certain associations of flora which have proved reliable indicators. The rates of growth under varying conditions of environment have never been quantitatively examined, but although the species has proved itself adaptible in nature to a considerable range of site-factors, yet it can be safely assumed that its rates of assimilation and growth are invariably conditioned and modified, not by the most favourable, but by the pace of the slowest and least favourable factor. Analogies from nature are therefore apt to be misleading unless all considerations are adequately weighed and borne in mind. There is evidence for instance that " first-class " areas of natural regeneration in Jalsur East reserve are lagging behind in rate of development, since the area was completely exposed, as compared with the artificially regenerated Hopea adjoining it wherein safe " average " conditions have been maintained throughout.

81. *Years of flowering and seeding of Hopea parviflora.*—Since the distribution of this species is largely influenced by seedfall, years of abundant seed have been more carefully noted for this species than others. The following information is compiled from various notes on the subject :—

The years 1909, 1911, 1917, 1923, 1927, 1929 were good or satisfactory seed-years in most parts of the division.

The years 1910, 1912, 1918, 1920, 1921, 1926, 1928 were bad seed years.

Other intermediate years gave a fair or moderate crop.

The crops in 1909 and 1929 were partly ruined by early rains or storms.

So far as can be judged from imperfect records over an inadequate period, it seems that a space of 4—6 years may separate two years of prolific seed production, which years are invariably followed by a year or two of comparative sterility and an intermediate year or two of moderate seed-formation. Intelligent anticipation of abundant seed-years amounting to certainty would be of great value in forest operations. This can, if ever, only be attained by prolonged records and comparisons with relative rainfall, humidity and other statistics. That climatic causes may be at least strongly contributory is likely inasmuch as other species, viz., *Eugenia Gardneri* and *Artocarpus hirsuta*, appear to flower well simulatenously with Hopea. It has been observed elsewhere that flowering is accompanied by an optimum of transpiration, provided that soil is relatively damp and the atmosphere relatively dry. Physiological causes are also undoubtedly present, and it is highly probable that flowering depends on a certain concentration of carbon assimilates and nutritive salts, especially of nitrogen and phosphorus ; hence a certain natural periodicity would be requisite for the renewed accumulation of these substances-advanced or retarded perhaps by favourable or unfavourable climatic conditions.

82. *Artocarpus hirsuta.*, " Hebbalsu " (Kan.).—This species is one for which a steady local demand exists which has hitherto readily absorbed the somewhat limited quantities which have been put on the market. Its importance as a high-grade timber ranks probably in the same class with *Dalbergia latifolia.* It is fast-grown and reaches to splendid proportions. Its association with *Hopea parviflora* in natural forest is well-known ; unfortunately it is not so gregarious in habit and is found growing singly or in somewhat scattered groups. Both fruit and young seedlings are liable to destruction by vermin, monkeys and insects. The conditions most suited to its germination and survival in youth are not greatly different

from the requirements of *Hopea parviflora*. It appears to succeed well in even more open situations than does Hopea. Spontaneous groups of seedlings and saplings are found distributed in moist deciduous forest, and sometimes in less advanced transitional stages or it may succeed well under a first quality crop of *Xylia xylocarpa* with moist undergrowth. Some very fine specimens are found in Subrahmania, Nalkur, Bantamale, Devachalla, Kiribag, and Yenekal reserves of Puttur Range, these being chiefly ghat or sub-ghat localities. It grows well on laterite but again prefers a deep ferruginous clayey or gneissic subsoil. It quickly becomes established and makes an excellent start in gaps and clearings in evergreen forest. Conditions have proved peculiarly suitable in Pilarkhan reserve of North Mangalore Division which are not exactly parallelled elsewhere in this division. In the abovenamed reserve a young pole and medium-aged *Hopea parviflora* forest is established on dry laterite soil; the undergrowth is semi-deciduous and regeneration of Hopea is scanty or entirely absent, but *Artocarpus* has established itself successfully in groups under gaps in the principal canopy or in the partial shade of taller trees. Introduced artificially, it shows signs of finding ideal conditions under somewhat open canopy on the more gentle northerly slopes of Aletti West Reserve formerly under mature Hopea and other evergreen species.

83. *Mesua ferrea,* "Naga Sampige" (Kan.)—This species is found on ridges in the evergreen zones of Kombar, Kiribag and Bantamale. In Bantamale it has kept to the eastern half and mingles but very incompletely with *Hopea parviflora*. On the ridge east of Kedamakal it mingles closely with that species. Regeneration of *Mesua* is scanty in spite of adequate seed fall, and it must be supposed that in common with other hardwoods, it requires light in early stages. Natural regeneration and advance growth in all stages, from seedling to poles, is seen however in Balpa reserve under moist deciduous conditions and along with natural Hopea regeneration. On the whole, the species seems to have established itself with remarkable facility and to be extremely sturdy, as well as somewhat faster-growing in youth than Hopea. It has not been observed to reach to very large girth sizes, but this is possibly due to the fact that the forests where it is seen do not seem to be over-mature or of very great age.

84. *Constitution of age-classes.*—Practically nothing is known about actual ages corresponding to the severeal girth-classes. The following table shows the approximate numbers in which the several girth-classes are present in enumerated areas which represent those forests nearest to maturity, covering an area of 1,938 acres :—

Botanical name of the species.	Girth-classes (one-foot gradations).						
	3′—4′.	4′—5′.	5′—6′.	6′—7′.	7′—8′.	8′—9′.	Over 9′
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Hopea parviflora	1,062	591	260	153	82	81	30
Artocarpus hirsuta	184	153	89	79	43	47	19
Mesua ferrea	35	44	32	27	22	14	16
Dysoxylum-malabaricum	..	..	..	2	3	..	1
Terminalia paniculata	2,240	2,056	971	494	241	98	19
Terminalia tomentosa	1,546	1,281	815	265	179	24	10
Lagerstœmia lanceolata	417	474	206	130	70	22	5
Dalbergia latifolia	56	60	30	19	3	..	..
Xylia xylocarpa	4,551	3,108	840	197	41	11	..
Tectona grandis	12	7	3	3	..	..	..
Miscellaneous spp.	554	529	295	210	116	81	59
Total ..	**10,657**	**8,303**	**3,541**	**1,579**	**800**	**378**	**159**

The remaining extent of deciduous forest in the division is relatively immature, the bulk of the crops thereon are between 2 feet and 5 feet in girth with a probable maximum in the 3 feet—4 feet class.

An area of 2,109·6 acres has been regenerated with young crops between the years 1915 and 1929.

No statistics can be taken as representative of the evergreen and semi-evergreen forests, since enumeration in Hopea patches are not representative of these as a whole.

Section 2.—Injuries to which the crop is liable.

85. *Wind.*—Exceptionally fierce storms sometimes arise locally during the hot months of April and May. These cause numerous windfalls and top-breaks, the latter damage particularly to *Xylia xylocarpa* poles about 15 or 20 feet above the base. This type of damage is not infrequently observed along slopes of hills, overlooking valleys.

Further inconvenience and loss is liable to be caused by early gales stripping Hopea seed-bearers of flower or unripened fruit. Such instances occurred in 1909 and 1929, both otherwise good seed years.

86. *Floods.*—The damage occasioned by the exceptional flood-years of 1923 and 1924 was not great, so far as can be ascertained. Some severe landslips occurred in places, notably in Kombar reserve, and many river-bank trees were carried down by the spate of waters. Timber stored at depots worth nearly Rs. 1,280 was washed away. The forest regions are on the whole admirably capable of draining off surplus water.

87. *Fire*—(1) *Cause and extent.*—Undoubtedly the major loss to forest crops is directly and indirectly occasioned by fire. The impression which seems to have been once held that in proportion to the extent of forest, fire incidence in South Kanara was of negligible dimensions cannot in truth be supported. The fire season is a comparatively short one and the actual extent of any single fire is rarely disturbing. But the process of attrition by which good deciduous forests are brought to serious depletion and degradation cannot be overlooked. Mr. Longrigg, in his Annual Administration Report for the district in the year 1916–17 stated :—" The present situation as regards forest fires is lamentable and I have no hesitation in saying that in few districts in the Presidency can the damage done by forest fires be so regular and widespread or the attitude of the people so indifferent." To the general apathy of the people and the apparent complacency, in many cases, of forest subordinates themselves, much of the present state of affairs must be attributed. A great many fires in remoter localities certainly pass unreported, and of those reported, only a small percentage are followed by offence reports. During the decennial period 1918–19 to 1927–28, out of 615 fires reported, 250 fires were traced as having begun inside forest boundaries ; 169 had entered from outside exterior lines, being chiefly escapes from kumaki lands ; 17 were due to causes unknown. Malicious incendiarism accounts for only 65 cases ; carelessness of travellers, cartmen and villagers traversing the forests led to 10 fires ; other causes were intentional ignition of the forest to drive out wild animals or for grazing purposes. The last named incentives, particularly the destruction of cover to animals, seems from the writer's observation to be very inadequately reported; it is a practice widely resorted to by villagers living in forest enclosures. The total acreage reported as burnt during the period is 24,093 acres, an average of 2,409 acres annually. It would probably be safe to double this figure in order to arrive at a truer estimate. The year 1917–18 was a severe year, when nearly 4,000 acres were burnt, chiefly in Uppinangady Range, largely owing to the seeding and death of bamboos. The year 1929–30 was likewise a bad year, partly owing to panic, occasioned by the presence of one or more man-eating panthers in Beltangady Range.

(ii) *Extent and nature of damage.*—Fires are generally ground-fires, rarely entering the crowns. The chief injury to older trees is done to the base of the stem by partial destruction of the cambial layer, hollowing out and charring of the base followed by unsoundness in the centre, spreading upwards. Ring-shake and heart-shake are generally from the same cause. *Terminalia* and *Lagerstrœmia lanceolata* are among those species principally affected ; teak, *Dalbergia latifolia, Xylia xylocarpa* and *Pterocarpus Marsupium* are more resistant.

Serious set-back to forest increment is however chiefly caused by the frequent reduction of saplings and seedlings to ground-level. Fresh shoots often appear with the following rains, but regeneration rarely acquires immunity from frequent fires and in time becomes sparse or absent altogether. Fires in the moister deciduous forests generally run up from vulnerable points adjacent to enclosures or rights-of-way to ridges and higher ground occupied by *Xylia* crops, but rarely obtain extensive entry into the low-lying tracts, which are protected very considerably by an evergreen undergrowth. Evergreen undergrowth rarely excludes a fierce fire but is adequate to prevent spread from a casual flame or spark. A fire, once entered into a reserve, is very apt to be repeated in subsequent years owing to the production of grass over the forest floor. Evergreen species, such as Hopea and *Artocarpus*, are exceedingly fire-tender. Mere scorching is sufficient to kill the stem. Natural regeneration of Hopea and *Mesua* in Balpa was partly killed off in 1930 by fire ; about 25 acres of Hopea plantation in Porkala reserve were also burnt during the same year, but about one-third of the destroyed crop had sent up green shoots from the roots after the rains.

(iii) *Damage to plantations.*—A table of fire occurrences in plantations is given below. The villagers of Ichlampady maliciously set fire to the 1921 Hopea regenerated area of Porkala reserve in March 1922 owing to discontent arising from closure to grazing in extensively sown areas. The whole reserve was closed to grazing for the remainder of the year. The punishment was light but seems to have had salutary effect.

Statement of fire occurrences in the plantations of South Mangalore Division.

	Parappa.			Porkala.			Padnur.			Mundajekap.		
Year.	Number of fires.	Area in acres.	Cause.	Number of fires.	Area in acres.	Cause.	Number of fires.	Area in acres.	Cause.	Number of fires.	Area in acres.	Cause.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	13)
1922 ..	..	..	..	1	60	Malicious intention.	1	60	Not known.	..	..	..
1923 ..	..	..	..	Nil	..	..	..	..	..	..	..	..
1924 ..	..	..	..	Nil	..	..	..	..	..	..	..	..
1925 ..	1	5	Not known.	Nil	..	..	..	..	..	..	..	..
1926 ..	1	2·80	Do.	Nil	..	..	..	..	..	..	..	..
1927 ..	1	0·20	Do.	Nil	..	..	..	..	..	1	1·50	By travellers.
1928 ..	1	0·25	Do.	Nil	..	..	..	..	..	..	..	
1929 ..	Nil	..	..	Nil	..	..	..	..	..	..	..	..
1930 ..	3	4·50	Not known.	1	25	By Shikaries.	1	·50	By travellers.	1	0·21	Escape from unreserves.
1931 ..	Nil	..	..	1	8	Not known.	..	..	..	..	..	..
Total ..	**7**	**12·75**	..	**3**	**93**	..	**2**	**60·50**	..	**2**	**1·71**	..

88. *Climbers.*—Giant woody climbers are most abundant in the evergreen, semi-evergreen, and moist deciduous tracts. They flourish particularly in those areas which have been despoiled and rendered too open or have not recovered from past kumri. In the drier deciduous areas they have caused considerable set-back to teak in Mandekole, Medinadka and Parappa. The teak kumris of Kasaragod Range have been inadequately tended in this respect, to which their rather poor development is in considerable degree attributable. Creeper-cutting conducted separately or in conjunction with improvement felling operations, was regularly done up to about 1920 under the old working plan but in recent years the establishment has been concentrated upon intensive timber and regeneration operations in a few localities. Herbaceous climbers in newly regenerated Hopea areas have to be very frequently cut back, since the opening of canopy in moist deciduous areas is a direct stimulus to their growth, and the slender stems of Hopea are unable to withstand their weight and can be completely borne down and killed by them. Semi-scandent creepers are numerous in clear-felled areas and other open patches. These, particularly *Hybiscus furcatus*, are a pest in unburnt fuel coupes (e.g., Nerankimale, Narimogar) where they form a thick matted growth over the tops of other species and stifle them.

89. *Weeds.*—(i) Under natural conditions in the forest, competition amongst subsidiary floor-species is so keen that one species rarely gains the upper hand to the exclusion of others.

(ii) Several species of *Strobilanthes* are present, but in comparatively few instances does this reach the nuisance stage. It is, however, a serious deterrent to all natural regeneration of deciduous species, including *Xylia*. When kept under control by competing flora, it appears to have little deterimental effect on Hopea seedlings, but the species found in conditions suitable otherwise for Hopea is rarely of the most obnoxious kind. *Strobitanthes* has gained a grip chiefly in moist deciduous forest where the middle storey of evergreen species has not developed very noticeably (e.g., Mujur Reserved Forest).

(iii) Lantana has generally only to be reckoned with on the edges of plantations and around clearings and enclosures. It has obtained a decisive grip in certain old kumried areas on laterite soil in Adur and Karadka reserves. It is also present in Muliar, Parappa, and Mandekole and a few similarly situated reserves.

(iv) Herbaceous weeds and fast-growing species gain an early footing in clear-felled areas and in the past have been responsible for the ruination of many acres of teak kumri and some plantations owing to inadequate tending. They are also responsible for the greater proportion of expenditure necessary in Hopea plantations, especially in natural regeneration areas where the upper canopy was too drastically or rapidly reduced. A species of *Leea* is one of the most difficult to deal with in moist localities with deep soil. The species grows in a dense thicket some 10—12 feet or more in height. Under canopy the effect of evergreen undergrowth on the regeneration of deciduous species has elsewhere been described.

(v) *Mimosa pudica* is a nuisance on laterite soil after clearings. It is generally most prevalent on the lower edges of plantations adjoining unfelled forest.

(vi) Coarse grass is common on fire-burnt hill-slopes. It has not hitherto proved a very dangerous weed in forest clearings. A height of 2 feet 6 inches is common but rarely exceeded.

90. *Parasites.*—Loranthus attacks teak to a limited but not dangerous extent. *Terminalia tomentosa* is occasionally attacked but in the mixed natural forests Loranthus is not prevalent.

91. *Animals.*—(i) Elephants are destructive to trees, saplings, bamboo clumps, etc., but to inappreciable extent. They prefer to keep to certain localities and along their own favourite tracks and in the dry season remove themselves to the cool upper slopes. More worthy of remark are the ravages made on paddy fields, areca gardens, and coconut topes and bunds in cultivation adjoining their haunts. Complaints by owners have been frequent since the Department ceased to undertake capturing operations. Elephants exist in Sampaje, Kilarmale, Kiribag, Shiradi-Sisla, parts of Mujur and the ghat-slopes of Subrahmanya and Kombar reserves.

(ii) Bison are responsible for some damage to the clear-felled coupes of Nerankimale reserve by trampling down seedlings and browsing coppice-shoots. They also occasion injury to *Artocarpus* and Hopea plantation areas by bending and breaking down the saplings to eat the leading shoots.

(iii) Sambhur browsing in Hopea and *Artocarpus* regeneration areas, and also to a small extent in clear-felled areas at Parappa have occasioned set-back to young plants. A further item of injury caused by sambhur is the stripping of the bark and cambium layer of saplings of about half inch or more in diameter, possibly as food but more often owing to a fondness for rubbing their antlers along the stems. Broken, forked and malformed stems result.

(iv) Cheetal or sambhur have badly browsed *Gmelina arborea* seedlings established at Parappa, thus imparting a bushy, much-branched appearance. Teak, *Terminalia tomentosa,* and *Dalbergia latifolia* have also been attacked. Vigorous weed-growth, however, probably helps considerably to reduce danger from browsing. Neither deer nor sambhur are at all numerous in the division, and the damage caused by them to plantations is small compared with that in most other divisions.

(v) Monkeys have not been observed to occasion great damage. They are alleged to be fond of the fruit of *Artocarpus hirsuta,* but the probability is that they discard many of the seeds and so may be actually instrumental in distributing them.

(vi) Squirrels, porcupine, and other vermin are destructive of the fruits of *Artocarpus hirsuta,* as also are pigs by grubbing up the seed. Here again the prevalence of other vegetation doubtless aids in the escape of many seeds, especially in evergreen forest.

92. *Insects.*—A considerable field of research is open in the investigation of insect damage to the forest crops of this division. Chief among the species liable to attack is *Hopea parviflora.* The following is an account of the principal injuries hitherto noted to this species :—

(*a*) *Young crops*—(i) *Borers*—The following have been identified :—

A borer belonging to the class of *Xyleborus Morastati Haged,* known as a borer of coffee in Southern India and of seedlings and twigs of *Swietenia microphylla* and *S. Mahagoni* in Ceylon and Java. The Forest Entomologist at Dehra Dun reported that this was the first record of its attack on *Hopea parviflora.* This was found at Mundaje Kap reserve of Beltangadi Range.

An insect, identified as '*Sphærotrypes,*' enters the stem and tunnels down to the root, finally completely destroying the infected plant. This was observed in the areas of natural Hopea in Jalsur East reserve of Kasaragod Range.

Borers of young saplings and seedlings are found to attack chiefly the weakly and suppressed specimens. In planted areas where a number are found at one stake in a small group, some inevitably become suppressed and the writer has noticed that infection amongst the less thrifty is very common, often at every stake. This leads one to suppose that the presence of suppressed seedlings after one or two have obviously outstripped the remainder is not only unnecessary but a definite danger to the crop since if the insect becomes numerous it will probably attack healthy specimens. Remedies are frequent inspections and destruction of the attacked seedlings by uprooting, burning or burying. The attacks by *Xyleborus Morastati* and *Sphærotrypes* in the reserves above-noted do not appear however to have become general, and it seems probable that in Jalsur East reserve at least the crop is old enough to have become immune from attack.

(ii) *Attacks to the cambium layer of young shoots.*—This type of damage is far more widespread than borer attacks in the young crop. It is responsible for a reduction of fully 50 per cent in the height-growth of seedlings, especially in artificially regenerated areas under deciduous crops. The insect gnaws at the surface tissues and generally succeeds in " ringing " the slender stem, which withers and dies. Quite often the first healthy flush is destroyed completely after attaining a length of 6—9 inches, and the permanent surviving annual growth is that put on by a fresh shoot at the latter end of the growing season after the insects have receded. This damage, although so common and widespread, has proved most difficult to trace to the offending culprit, as he is rarely caught *in flagrante delicto* and is a night feeder. The following have been found on leading shoots and identified :—*Hyperaxis Malabarica Jacob* (a *Chrysomelid* beetle) ; the species thought responsible for the gnawing of the rind of twigs are identified as a species of *Nodostoma* and a weevil, *Eups nietneri Jekel.* The life-histories of these insects are imperfectly known and control measures are uncertain.

(iii) *Attacks on the foliage.*—Numerous other insects attack the tender foliage of seedlings, including leaf-rollers. Grass-hopper nymphs are largely responsible for semi-circular cuttings in the leaf. *Nodostoma* probably also damages the leaves. Damage to the extent of defoliation is, however, unknown.

(*b*) *Attacks on older wood.*—In timber felled from the mature and over-mature stock in Aletti West (Kasaragod Range), the larvæ of *Massicus venustus* Pase (*Cerambycidæ*) have bored large oval galleries in the heartwood. Infected specimens of timber were sent to the Forest Entomologist at Dehra Dun. Another borer, viz., *Agrorhynchus cmaculatus* (*Brenthidæ*) has been found in Kasaragod Range.

Defoliators on teak are found in both Parappa and Sampaje reserves, although these being mixed woods the damage is not excessive. But for constant picking, however, the larvæ of *Hyblœa puera* would have ruined the Sampaje nursery in 1930. Borer attacks in *Artocarpus hirsuta* seedlings have occasionally been found and galleries may pass down the entire stem to the root. The insect has not however been isolated.

93. *Fungi.*—Little is known on this subject. Fungi are generally the after-result of external injury (fires, etc) ; fructifications indicating heart-rot are commonly apparent near the base of the stem. In over-mature stems of *Hopea parviflora,* rot is sometimes observed to extend downwards from the crown, probably the result of damage at the base of a branch, the collection of water at a fork and subsequent fungoid attack.

94. *Man.*—Unlicensed extraction of timber and other produce for domestic purposes or commercial profit has in the past taken severe toll. It was recorded in 1870 that the jungles at the foot of Sampaje ghat contained much valuable young teak, although mature trees were scarce " owing to reckless felling by Mangalore merchants in former years " ; that at Subrahmania there was first class " Blackwood " (*Dalbergia latifolia*) and that Poon (*Calophyllum*) and Aini (*Artocarpus hirsuta*) had been largely worked out. The peculiar rights of the country known as " Kumaki " have always been a thorn in the side of the management. This was reported by Mr. Cherry in 1870 to be an easy cloak under which to cover smuggling out from Government forest of large quantities of timber. Forests were, according to Mr. Cherry, " stripped of all timber and even brushwood before the wargdars were forced, in the most accessible localities, to fall back on their own holdings." The Revenue authorities at that time took a curiously lenient or mistaken view-point in the matter, and control exercised over timber withdrawals was lax in the extreme. Mr. Thomas, the Collector of South Kanara, reported naively in a letter to Government in 1868 that there was " unmistakable evidence " that the " true conservers of timber-land " were the kumaki and warg-holders ! The state of affairs did not alter materially for some years. Subsequently in 1907, and again in 1917, it was reported that wargdars were still evading the timber transport rules, many cases of abuse of kumaki privileges existed, and that revenue officials were not interested in protecting Departmental interests. About two-thirds of the offences reported were on account of unauthorised fellings. The forest staff was inadequate for protective duties. Latterly more stringent enforcement of the regulations has been displayed, especially in Puttur and Uppinangady Ranges, with the result that 532 cases of unauthorised felling were detected out of a total number of 775 offences dealt with in 1922–23. Stringent orders of the Collector against failure on the part of village officers to report all cases of illicit felling in time, and the promise of rewards to revenue inspectors, had due effect. Many cases of theft of reserved species from kumaki lands cannot be taken to court on account of lack of evidence ; but pattadars, who are supposed to guard their kumakies, generally pay compounding fees on threat of withdrawal of their kumaki-privileges, although in almost every instance complaining of malicious action of others. In the southern parts of Kasaragod taluk, contituting the Nileshwar magane to which special kumri rights were allowed, large thefts of timber as well as illicit kumri cultivation has continued until recently. In 1923–24, the sum of Rs. 2,458 was collected in compounding fees from this part of the country, being over one-third of the total for the whole district. The situation in the Hosdrug section led to enquiry and decision to reserve certain portions of land under Sections 4 and 16. The matter of settlement in Hosdrug section still continues.

In all recent reports, the working of the Timber Transit Rules is said to be satisfactory.

Illicit felling still continues, largely for local and domestic use, and is often confined to poles and small trees of about 6 inches diameter. The lopping of branches from trees for the purpose of brushwood and manure leaves is no uncommon occurrence. Abuses of manure leaf concessions have been dealt with under paragraph 49.

To summarise, large-scale thefts of timber no longer take place but considerable petty fellings for small domestic purposes continue around the fringes of the forest especially in Kasaragod Range and from unreserved Government waste-lands.

CHAPTER III.—UTILIZATION OF THE PRODUCE.

SECTION 1.—AGRICULTURAL CUSTOMS AND WANTS OF THE POPULATION.

95. The wealth of timber and minor produce still existent in the unreserved and reserved waste-lands of the district, in addition to the unique rights and privileges known as " kumaki," " kan," and " bane " lands, render the local demand on reserved forest produce extremely light.

96. The following list shows the principal utility species :—

(*a*) *Agricultural implements*—

(i) Ploughs—*Strychnos Nuxvomica, Careya arborea, Terminalia paniculata, Cassia fistula, Bridelia retusa.*

(ii) Yokes—*Adina cordifolia, Calophyllum tomentosum, Grewia tiliæfolia, Bridelia retusa.*

(iii) Levelling planks—*Lophopetallum Wightianum.*

(iv) Thrashing pestles—*Xylia* poles.
(v) Axe-handles—*Xylia xylocarpa, Hopea parviflora, Hopea Wightiana, Grewia tiliæfolia.*
(vi) Fencing posts—Any species available, preferably *Xylia xylocarpa,* with bamboo battens.

(*b*) *Building purposes*—
(i) Temples and house-construction—
Artocarpus integrifolia (pillars, door and window-frames, planks, etc.).
Artocarpus hirsuta (beams, hip rafters, wall-plates, etc.).
Hopea parviflora (especially in temple construction).
Terminalia tomentosa (rafters, verandah posts, etc.).
Lagerstrœmia lanceolata (roofing work).
Albizzia Lebbek.
Xylia xylocarpa (posts).
Tectona grandis (doors and windows).
Dalbergia latifolia (doors and windows).
Mangifera indica (planks).
Vitex altissima (planks).
Terminalia belerica (planks).
Vateria indica (largely for rough use and miscellaneous purposes).
Lophopetallum Wightianum (planks and rough usage).
Holoptelia integrifolia (planks and rough usage).
(ii) Furniture and cabinet-wood—
Tectona grandis, Artocarpus integrifolia, Adina cordifolia, Dalbergia latifolia.
(iii) Cow-pens, sheds and small huts—
Vitex altissima and *Careya arborea* for mud-walls, *Bambusa arundinacea* for roofing battens, etc. *Terminalia tomentosa* and *Terminalia paniculata* for posts, pillars, etc.

(*c*) *Miscellaneous*—
(i) Boat-making—*Mangifera indica, Tetrameles nudiflora, Artocarpus hirsuta.*
(ii) Well-curbs—*Phyllanthus emblica.*
(iii) Rice-pounders—*Eugenia jambolana, Odina Wodier, Albizzia* spp.
(iv) Oil-mills—*Albizzia Lebbek, Schleichera trijuga.*
(v) Charcoal making—*Schleichera trijuga, Terminalia tomentosa, Hopea Wightiana.*

97. Below are given a few of the minor products used locally :—
(i) *Bamboos.*—These are of universal application.
(ii) *Reeds.*—Used locally in the construction of "kadike" thatties for storing rice.
(iii) *Canes.*—for rattan baskets, walking sticks, ropes, cart-hoods.
(iv) *Fruits.*—The fruits of *Artocarpus Lakoocha* are largely used locally as a substitute for *Tamarindus* fruit. The outer covering of *Garcinia Morella* fruits is dried and used for cooking purposes. *Eugenia-jambolana, Zizyphus-xylopyrus* and *Anacardium occidentale* fruits are also collected as being edible. The fruit of *Terminalia chebula* is used for tanin, but is not common. Medicinally, the following are in use locally :—
Garcinia, Terminalia chebula, Terminalia belerica.
(v) *Barks and fibres*—
(*a*) *Antiaris toxicaria* ("Gajamara") bark. Straight boles of this tree are cut to the required length of fibre. The bark all round this log is beaten with a light, smooth mallet until the surrounding fleshy matter falls away from the fibre, which is then separated from the stem and immersed for several hours in water to remove all remaining fleshy matter. It is used as bags for storing grain, and as bedding.
(*b*) *Helicteres Isora* bark.—Sticks are cut and kept soaked in water for several days after which they are carefully beaten until the fibre is detached from the inner stems. After drying, the fibre is twisted into ropes.
(*c*) *Sterculia villosa* ("Ane-naru" or "Banna-naru"). The fibre of this species is used in rafting work, and for binding roofing material.
(*d*) *Terminalia tomentosa* ("Banapu") bark is in considerable local use for the preparation of "chunam." The bark is peeled off a few feet from the ground and burnt. The operation is not a licitly recognized one but widely practised. So far as has been observed, it does not cause permanent harm to the tree which quickly forms a fresh and somewhat thicker cortex over the wound.
(*e*) *Machilus macrantha* ("Gulmavu") bark. The well-known fleshy material of the cortical tissues is crushed and used for mud-plastering. It affords cementing matter and imparts a polish to the exterior.

(*f*) *Cinnamomum* bark (" Dalchine ").—The thin bark is used for spices. Oil is not usually distilled from the bark found locally.

(vi) *Herbs used medicinally.*—*Sida rhombifolia* (" Kadir " or " Kurudoti for kashayams) ". *Hemidesmus indicus* (" Haluberu ")—the syrup known as " Sarsaparilla " ; *Ophiorrhiza Mungos* and *Rauwolfia serpentina* (" Garudupathala ") roots used for antidotes for snake-bites ; *Hollarrhena antidysenterica* (" Madarasa ") for dysentery ; *Curucuma* (" Kuvai ") or Indian arrowroot ; *Aristolachia indica* (" ishwara-gida ")—the bitter root used as a stimulant and febrifuge.

(vii) *Miscellaneous.*—*Areca catechu* (" Adike ") is commonly cultivated for betel in well-watered topes within reserved forest. It also grows wild in evergreen forests. *Caryota urens* yields toddy, a strong fibre is made from the leaves, and the stem is used for aqueducts. It is common in evergreen forests.

Section 2.—Markets and Marketable Products.

98. The only markets of importance are on the West Coast. The Western Ghats cut off all inland traffic. Timber and major produce goes to Mangalore or Kasaragod. A considerable quantity of minor produce goes to Tellicherry. Mangalore Bunder depot is at the junction of the Netravati and Gurpur rivers as they flow out to sea. Kasaragod log depot is also accessible from the mouth of the Paiswani river. The principal markets are local, and therefore limited. Formerly a certain quantity of higher grade timber (teak, *Hopea parviflora* and *Dalbergia latifolia*) found its way north to Kathiawar, Ratnagiri, Mormagoa and Bombay, by country craft. Demand for cheap material, the unreliability of consignments by country craft, and more particularly, the heavy quantities of teak and other species now extracted from all four Kanara Divisions of Bombay Presidency and which is brought to within easy reach of these centres have effectively for the present cut off markets to the north. In the south, inland centres of demand in Madras Presidency are being met from the Nilambur, Palghat, and Coimbatore Divisions, which operate more effectively by reason of shorter lead.

There would seem little possibility for the South Kanara Divisions to extend their markets considerably during the next decade. There has always been a tendency to accumulate produce, both log and sawn timber, in coastal depots, and the lying-over of undisposed stock does not operate advantageously in the matter of prices offered. The Sri Lakshmi sawmill at Kasaragod has annually taken a limited quantity of logs until the operation of the Government sawmill at Parappa from 1927 to 1930 caused them to look partly to North Mangalore Division for supply. Their annual requirements for the future are estimated at about 50,000 cubic feet of logs, of which 30,000 cubic feet are *Terminalias* and *Xylia,* and 14,000 cubic feet *Lagerstroemia lanceolata.* Timber operations have of recent years depended increasingly upon the railway sleeper supply of both broad and metre gauges in teak, *Hopea parviflora* and *Xylia xylocarpa* for consuming the large surplus of extraction yields over local log consumption and sawn timber demand. Private timber merchants in Mangalore compete with the Government depot to some extent successfully from other sources of supply, e.g., private wargas and " hadies," and are able to compel custom by their more elastic " give and take " methods of salesmanship.

99. *Fuel.*—The local demand in the villages for fuel from Government reserves is practically non-existent, owing to the quantity of small brushwood usually available from unreserves, " kumaki " and private wargas. Some demand at Puttur is met by the neighbouring Narimogar coupes. Demand at the coast is always present, and this has again been met largely from private resources (e.g., casuarina topes) ; but fuel scarcity threatens to become intense towards the southern parts of Kasaragod Range in the next 10 to 15 years owing to rapid depletion of fuel sources in the interior. Government reserves have not hitherto been very conveniently situated to meet coastal demand, except in a few instances. Few contractors are willing to come forward for our coupes, and are usually the same men year after year, so that no competition exists to keep up prices. Contractors with adequate resources are not usually attracted. There has been in consequence a steady downward trend in prices offered year by year, and in the past twelve months three coupes have failed to fetch buyers, or the bids were too poor to be acceptable.

Normal prices for firewood in Mangalore were until recently between Rs. 28 and Rs. 34 per " chowk " (1 " chowk " is equivalent to 216 cubic feet of fuelwood billeted and stacked, or about 3 tons), depending on quality. The hardwoods, especially *Hopea Wightiana,* are preferred. *Hopea Wightiana* is sometimes shipped to Bombay. In common with all commodities, current prices of fuel at the time of writing have slackened to about Rs. 18 to Rs. 24 per chowk. The tile industry of Mangalore has in the past required large quantities of billet fuel, but its use is to some extent being replaced by coal.

North Mangalore Division is in a more advantageous position to bring fuel to Mangalore owing to the greater proximity of its coupes to the seacoast. Road transport as usual is unable to compete successfully with sea and river-borne traffic. There is reason to suppose that our coupes if worked departmentally, would still yield a fair profit, but there is indisposition to add this burden to the staff.

100. *Minor produce.*—The district is rich in minor produce, the leases for which yield not inconsiderably to revenues. The right of collecting scheduled minor produce in reserved forest, reserved lands and unoccupied assessed waste is leased annually by public auction through the agency of Revenue authorities. The division of South Mangalore is divided into 50 convenient-sized " farms," notified by villages and reserves. The method is employed chiefly for convenience, since a large proportion of the total leased areas in each case covers land exterior to reserved forest and is thus properly dealt with by the Revenue authorities. By arbitrary arrangement, half the revenues derived by sales in auction are credited to " forests " and half to " land revenue." The right of refusal, reservation and cancellation of contracts is held by the District Forest Officer. Long lease for the cultivation of cardamoms within reserved forest are contracted for direct with the District Forest Officer. Permits are issued separately for the local collection of bamboos, or other specific produce. Minor produce within " kumaki " lands when not consumed by the kumakidar himself can only be disposed of to the minor produce lessee within the " farmed " area by mutual arrangement between them.

101. The following are the principal of minor products extracted :—

(i) " *Rampatre* " or " Ramgot " (fruits of *Myristica malabarica*—" Wild mace " or " false nutmeg ").—This is used as a flavouring agent, especially in the adulteration of nutmegs. The crop is biennial and is said to yield about 25 tons in a good year.

Note.—This figure refers to the whole of South Kanara.

It was formerly exported to Europe per Messrs. Pierce Leslie & Co., and Messrs. Volkart Bros., now by smaller firms.

(ii) " *Shigekai* " (pods of *Acacia concinna*).—The crop is said to be about 100 tons every alternate year for the whole district of South Kanara. It is shipped largely to Bombay.

(iii) *Cardamoms* (*Elettaria cardamomum* fruits).—About 3,800 acres of the ghat forests of the division are leased out for cardamom cultivation, the leases running continuously for 30 or 40 years. In addition, there is a very large private cardamom estate known as the Neriya Estate, south of the Charmady Ghat road. The right of cardamom collection outside these estates is leased annually. The revenue derived from cardamoms by the district is approxiamtely Rs. 1,413 per annum.

NOTE.—The cardamom estates are situated at an elevation of about 1,200 and 1,800 feet, in moist evergreen forests, watered by perennial streams. Only the sheltered valleys alongside streams are actually cultivated ; plots vary from about 1 to 10 acres in extent. Almost complete canopy is required. Trees are at varying distances apart, averaging about 20 feet. The crop is raised from seed or nursery-raised seedlings, the latter planted when two to three feet high and about 18 months old. Picking begins in September and lasts until December or January. They are picked when ripe or almost ripe. Those picked during the rains are carefully dried in sheds over a heated platform ; those picked later are sun-dried. The capsules are then cleaned, bleached and graded. The market is Mangalore, whence they are exported. Market prices have fluctuated widely. In 1926 the price was Rs. 125 per maund of 28 lbs. ; the current price is between Rs. 18 and Rs. 20.

(iv) *Hopea parviflora* bark, for tanning purposes.—Enquiries from Messrs. Gordon Woodroffe and Co., Madras, led to the collection of 30 tons 14 quarters of Hopea bark in 1929–30, of which 24 tons and 22 quarters were actually delivered, at the rate of Rs. 80 per ton f.o.r. There was some deterioration owing to damp. Total net profit on the transaction was Rs. 400. Further deliveries have been suspended. The bark is said to impart a reddish tinge, of rather variable quality, not very suitable for European export, and the exporters find they can get better results from " Wattle " bark imported as cheaply as we can supply Hopea bark. There is a probability however that local tanning firms can be interested. The Superintendent, Leather Trades Institute, is endeavouring to find markets. About 60 to 70 tons could be supplied annually.

(v) " *Naga* " canes (*Calamus rotang*) have been collected for many years, especially from Kiribag reserve. They are exported mainly to Tellicherry. The method of extraction, has however, seriously threatened further supply, and the lease has been discontinued.

(vi) *Piper longum* (as an adulterant to the cultivated variety of pepper).

(vii) *Strychnos Nux-vomica* are also exported but the supply far exceeds the demand.

(viii) *Cashew nuts* (*Anacardium occidentale*) have had a uniformly increasing market abroad chiefly in America. The total quantity exported from Mangalore is now 2,000,000 lbs., annually and is not constant. The oil is a useful insulator, having powerful dielectric properties, and is a wood preservative. The fleshy " fruit " contains a high percentage of alcohol. The wood is used for fuel.

(ix) " *Wood oil* " from *Hardwickia pinnata* is used locally as a wood preservative, but has a very little export. The oil is collected in tins by ryots on behalf of the contractor. It is sold at about Rs. 12 per tin of four gallons. The present revenue from wood oil is from Rs. 300 to Rs. 500 per annum.

(x) " *Wood oil* " from *Dipterocarpus indicus* is also extracted and used as an adulterant to the above.

(xi) *Cinnamom oil* from the leaves buds and flowers of " kadva," " kara " and " thej " varieties (possibly *Cinnamomum riparium, C. zeylanicum, C. ineris* respectively) is distilled in local stills.

102. *Methods of marketing timber.*—Kasaragod depots for logs and sawn material were handed over to the Forest Utilization Officer early in 1927 chiefly for the disposal of sawn material from Parappa sawmill. The log depot was again handed back to the District in June 1930. Railway sleepers are passed by the Forest Utilization Officer and handed over to the Railway Company. Sales of timber are by public auction at depots, by tender, or in retail at fixed depot rates. Dead and wind-fallen trees are sold by local auction at site. Porotes and sawing refuse are sold " *in situ* " at depots for what they will fetch. Fuel coupes are sold standing, by local auction, at convenient centres, viz., Kasaragod, Puttur or Uppinangady.

103. *Auction sales.*—Both demand and competition at Bunder depot are fitful and incalculable. Bidders at auction sales number between three and ten, the average being about five or six, generally local merchants.

Competition has markedly slackened off during the last nine months. Prices have dropped from 3 to 5 annas per cubic foot on non-teak species, since 1928. The tendency for our depots to become over-stocked is well known, and advantage is probably taken of this fact to underbid deliberately at certain seasons. This applies with more force to sawn produce subject to degrade. Merchants frequently obtain better terms in the bazaar, being afforded facilities for personal selection, and the discarding of cracked ends and odd lengths below 6 inches from calculation.

104. *Log sales.*—Logs of *Terminalia tomentosa* (banapu) and *Terminalia paniculata* (marwa) obtain better prices than scantlings. Teak (first and second grades) always sells well in the log, but third grade and poles have little demand. First and second grade logs fetch from 3 to 5 annas per cubic foot better prices than third grade, of which in banapu, marwa, benteak (*Lagerstroemia lanceolata*) and benga (*Pterocarpus Marsupium*) there is a very limited consumption. Old stock which has lain in depot, particularly of marwa and benga, is difficult to clear, but fresh, straight selected logs can generally be sold at prices ranging between Re. 0–12–0 and Re. 1–4–0. It is incumbent therefore to clear off old stock and to bring in no more to depots than is anticipated can be readily disposed of.

105. *Sawn produce.*—In sawn material there are complaints that *Xylia* scantlings are cut too much from side slabs, and not in good lengths. Kolmarams and chattams are rarely sold as such locally, but 6″ × 4″, 6″ × 3″, 5″ × 2″, 4″ × 3″ and 3″ × 2″ sizes are all in general use. These are now sorted into regular lots at depot. *Artocarpus hirusta* planks of 2 inches thickness fetch better prices in the broadest planks, i.e., 15 inches and over, up to Rs. 2–10–0 per cubic foot. This species was not well reported on as a sleeper wood, being attacked by dry rot, but is in wide local usage as a furniture and constructional timber. *Calophyllum tomentosum* has been difficult to sell at any reasonable margin of profit in recent years ; squares, kolmarams and chattams were disposed of at Kasaragod at a loss, and planks of miscellaneous sizes fit for boat-building were sold at Bunder, Mangalore, with difficulty in 1929 at Rs. 1–6–0, the approximate cost of delivery of these being Rs. 1–0–7 per cubic foot, exclusive of dragging and overheads. Sales of this species are best confined to order of the Forest Utilization Officer, who might be able to work up demand for special requirements from time to time, e.g., in railway carriage and truck manufacture. *Eugenia Gardneri* has hitherto found no market. In 1929, by order of the Forest Utilization Officer, 100 broad gauge and 100 metre gauge sleepers were supplied to the railway company free of cost for test purposes. A report recently indicated some slight prospect of further orders, 56 per cent broad gauge sleepers being reported good in all respects, and 24 per cent only slighlty split or attacked by white ants. Further report on the metre gauge sleepers is awaited at the time of writing.

Dysoxylum malabaricum (white cedar or " Agil ") is another excellent constructional timber not finding a ready local market and best supplied to order of the Forest Utilization Officer.

106. The following statements show the quantities sold and prices obtained in auction at Bunder and Kasaragod depots.

Receipts and disposals of timber for seven years ending 1929–30 *and the balance of stock undisposed of at Kasaragod Depot.*

Particulars.	1923–24. Receipts.	Disposals.	Balance unsold.		1924–25. Receipts.	Disposals.	Balance unsold.		1925–26. Receipts.	Disposals.	Balance unsold.	
(1)	(2)	(3)	(4)		(5)	(6)	(7)		(8)	(9)	(10)	
	C. FT.	C. FT.	C. FT.	PER CENT.	C. FT.	C. FT.	C. FT.	PER CENT.	C. FT.	C. FT.	C. FT.	PER CENT.
Log	50,298	19,952	30,346	60	24,884	23,879	1,005	4	22,500	15,322	7,178	32
Sawn timber (including mill production) ..	7,168	5,215	1,953	27	7,985	7,943	42	½	5,285	5,112	173	3

Particulars.	1926–27. Receipts.	Disposals.	Balance unsold.		1927–28. Receipts.	Disposals.	Balance unsold.		1928–29. Receipts.	Disposals.	Balance unsold.		1929–30. Receipts.	Disposals.	Balance unsold.	
	(11)	(12)	(13)		(14)	(15)	(16)		(17)	(18)	(19)		(20)	(21)	(22)	
	C. FT.	C. FT.	C. FT.	PER CENT.	C. FT.	C. FT.	C. FT.	PER CENT.	C. FT.	C. FT.	C. FT.	PER CENT.	C. FT.	C. FT.	C. FT.	PER CENT.
Log	25,321	15,969	9,352	38	23,909	10,630	13,279	55	8,240	3,018	5,222	51	7,481	5,671	1,810	25
Sawn timber (including mill production) ..	5,071	2,759	2,312	46	..	..	..	..	68,168	32,578	35,590	52·18	9,599	48,115	141,484	79

Receipts and disposals of timber for five years ending 1929–30 *and the balance of stock undisposed of at Bunder Depot.*

Particulars.	1925–26. Receipts.	Disposals.	Balance unsold.		1926–27. Receipts.	Disposals.	Balance unsold.	
(1)	(2)	(3)	(4)		(5)	(6)	(7)	
	C. FT.	C. FT.	C. FT.	PER CENT.	C. FT.	C. FT.	C. FT.	PER CENT.
Log	13,271	4,979	8,292	62	10,760	4,185	6,575	61
Sawn timber (including Parappa mill production)	2,375	1,010	1,365	58	9,490	5,179	4,311	46

Particulars.	1927–28. Receipts.	Disposals.	Balance unsold.		1928–29. Receipts.	Disposals.	Balance unsold.		1929–30. Receipts.	Disposals.	Balance unsold.	
	(8)	(9)	(10)		(11)	(11)	(12)		(13)	(14)	(15	
	C. FT.	C. FT.	C. FT.	PER CENT.	C. FT.	C. FT.	C. FT.	PER CENT.	C. FT.	C. FT.	C. FT.	PER CENT.
Log	10,408	8,011	2,397	22	14,088	12,341	1,747	12	27,030	20,484	6,546	2[illegible]
Sawn timber (including Parappa mill production)	6,609	5,060	649	9	5,921	5,37[illegible]	548	9	3,343	2,451	89[illegible]	2

Average rates realized in auction and by tender.

A. Kasaragod Depot.

Species and kind.	Year. 1920–21.	1921–22.	1922–23.	1923–24.	1924–25.	1925–26.	1926–27.	1927–28.	1928–29.	1929–30.
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.			RS. A. P.
Logs (per c. ft.).										
Tectona grandis	0 12 7	0 14 5	..	1 3 7	1 2 11	1 10 0	1 5 9	..	..	0 14 1
Terminalia tomentosa	1 8 6	1 5 7	..	1 3 9	0 12 1	1 4 8	1 1 3	..	..	1 1 5
Terminalia paniculata	0 15 0	0 13 4	..	0 12 9	0 13 5	0 13 11	0 8 11	..	..	0 9 2
Pterocarpus marsupium	0 13 0	..	..	0 13 0	0 12 3	1 5 0	1 1 10	..	..	1 0 0
Lagerstroemia lanceolata	..	0 13 5	..	1 0 6	0 13 0	1 0 6	0 13 8	..	..	..
Lagerstroemia flos-reginae	..	0 15 10	..	1 0 1	0 13 9	0 12 1	1 1 10	..	..	..
Dalbergia latifolia	1 9 11	..	..	..	1 1 10	2 1 9	1 8 3	..	..	..
Hopea parviflora	1 12 10	1 7 3	2 2 6	1 0 3	0 14 6	..	..	..	..	..
Artocarpus hirsuta	1 7 0	4 8 0	..	..	..	1 10 0	..	..	..	..
Artocarpus integrifolia	..	..	0 12 0	..	..	1 6 0	..	..	..	..
Hopea odorata	..	..	..	..	..	..	..	..	..	..
Albizzia sp. (K.K. bagi)	..	..	..	1 4 3	0 10 3	0 14 5	0 9 0	..	..	..
Albizzia sp. (Pulibagi)	..	0 11 11	..	0 4 9	0 10 3	0 14 0	0 14 3	..	..	..
Vitex altissima	1 7 7	1 2 8	1 0 4	..	0 14 1	..	..	..	..	..
Eugenia Gardneri	..	..	..	..	0 13 8	0 6 4	..	..	..	..
Vateria indica	..	..	..	..	..	..	..	..	..	..
Calophyllum tomentosum	..	..	..	..	0 14 0	..	..	..	..	..
Odina Wodier	..	0 9 2	..	..	..	..	..	..	..	..
Dysoxylum malabaricum (Agil).	..	..	0 13 0	..	..	..	..	..	..	..
Bridelia retusa	..	..	0 13 9	..	0 12 0	0 14 3	0 9 0	..	..	..
Xylia xylocarpa	1 7 0	1 12 5	..	0 15 1	0 12 4	0 13 1	1 0 0	..	..	..
Hopea Wightiana	..	..	..	..	0 13 11	..	..	..	..	..
Scantlings (per c. ft.).										
Tectona grandis	..	1 1 0	3 12 11	0 15 2	..	..	2 2 0	..	..	1 9 11
Terminalia tomentosa	..	2 0 1	2 4 0	1 7 3	1 5 0	..	..	..	..	..
Terminalia paniculata	..	..	1 5 0	..	1 1 2	..	..	..	..	..
Lagerstroemia lanceolata	..	..	1 15 9	1 9 3	1 8 2	..	2 3 1	..	..	..
Lagerstroemia flos-reginae	..	..	1 10 0	0 14 2	1 1 11	..	..	..	..	..
Pterocarpus marsupium	..	..	..	1 2 7	..	..	..	..	..	..
Dalbergia latifolia	..	..	3 4 7	2 4 1	..	..	..	..	..	..
Albizzia sp. (Pulibagi)	..	..	..	..	0 13 2	..	..	..	..	..
Albizzia sp. (K.K. bagi)	..	..	..	..	1 8 11	..	..	..	..	..
Vitex altissima	..	..	1 11 9	..	1 1 0	..	..	..	..	..
Xylia xylocarpa	..	..	2 9 11	1 5 1	1 5 0	1 12 [illegible]	1 10 [illegible]	..	..	..
Hopea parviflora	..	2 7 1	1 12 0	1 11 7	1 1 7	1 12 5	1 11 1	..	..	..
*Sleepers.**										
Hopea parviflora	..	..	..	..	..	..	..	..	..	..
Xylia xylocarpa	..	..	..	..	..	..	..	..	..	..
Terminalia tomentosa	..	..	..	..	..	..	..	..	..	..
Panels.										
Lagerstroemia lanceolata	..	1 12 0	..	..	1 9 11	..	..	..	..	..
Poles.										
Tectona grandis	..	..	0 10 8	..	..	1 1 3	..	..	..	..
Miscelleaneous.										
Rejected sleepers	..	..	..	..	..	2 0 0	2 11 7	..	..	..

* Rates for sleepers were as follows :—

	RS. A. P.		RS. A. P.
Xylia—		Hopea—	
Broad gauge—		Broad gauge—	
I class	8 0 0	I class	5 11 0
II ,,	5 5 0	II ,,	5 8 0
Metre gauge—		Metre gauge—	
I class	3 0 0	I class	3 0 0
II ,,	2 0 0	II ,,	2 0 0

B. Bunder Depot.

Species and kind.	Year. 1920–21.	1921–22.	1922–23.	1923–24.	1924–25.	1925–26.	1926–27.	1927–28.	1928–29.	1929–30
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P
Logs (per c. ft.).										
Tectona grandis	1 1 2	2 0 7	1 12 0	1 8 0	1 15 4	1 5 11	2 0 10	..	..	..
Terminalia tomentosa	1 8 1	1 2 0	1 0 10	1 5 10	1 5 5	1 2 11	1 2 2	1 1 10	1 1 8	0 12 7
Terminalia paniculata	0 12 8	0 15 3	0 13 0	0 15 8	0 11 9	0 13 8	0 12 7	0 13 2	0 11 7	0 12 3
Pterocarpus marsupium	1 0 0	1 8 3	1 4 5	..	1 1 0	1 3 11	1 1 3	1 8 0	0 11 0	1 0 9
Lagerstroemia lanceolata	1 1 1	1 1 3	0 15 8	1 0 8	1 1 11	1 0 10	0 14 1	1 10 11	1 1 6	1 0 10
Lagerstroemia flos-reginae	..	..	..	..	..	..	..	..	..	..
Dalbergia latifolia	1 6 8	1 15 5	2 5 4	1 8 7	1 0 10	1 5 7	1 9 6	1 15 8	1 7 2	1 13 4
Artocarpus hirsuta	..	..	..	..	..	..	2 8 1	2 7 1	..	..
Hopea odorata	..	..	..	1 0 1	0 15 10	..	..	..	..	..
Albizzia sp. (K.K. bagi)	1 0 0	1 0 0	0 13 3	1 2 4	0 15 11	0 14 0	0 11 0	0 15 9	0 9 0	0 11 6
Albizzia sp. (Pulibagi)	0 11 11	0 12 1	..	1 2 9	1 4 0	0 14 0	0 11 10	0 11 8	..	..
Albizzia sp. (Kalbagi)	..	..	..	..	..	..	..	..	..	..
Adina cordifolia	0 12 0	0 10 0	..	..	..	..	1 0 9	0 11 0	0 14 0	..
Bridelia retusa	..	..	..	1 3 3	..	..	0 11 7	..	..	0 12
Xylia xylocarpa	1 2 10	1 11 4	1 5 7	1 8 0	1 2 7	1 1 10	0 12 4	..	..	1 4 0
Eugeina spp.	..	..	..	..	..	..	..	..	..	0 12 9
Machilus macrantha	..	..	..	..	..	..	0 14 0	..	..	..
Scantlings.										
Tectona grandis	..	..	..	..	2 4 7	1 9 4	2 10 0	1 9 0	..	..
Terminalia tomentosa	..	2 2 4	2 3 7	1 4 0	1 15 7	1 15 0	1 1 1	1 5 4	..	1 8 3
Terminalia paniculata	..	..	..	..	1 6 0	1 14 1	1 3 0	..	..	..
Lagerstroemia lanceolata	..	..	..	..	1 10 5	2 13 2	1 5 6	..	..	..
Lagerstroemia flos-reginae	..	..	..	..	1 3 2	..	..	..	..	..
Pterocarpus marsupium	..	..	..	..	1 13 1	1 11 1	1 12 2	..	..	..
Dalbergia latifolia	..	..	..	..	2 6 2	2 10 0	2 10 3	..	..	..
Albizzia sp. (Pulibagi)	..	..	..	..	1 10 1	..	..	..	..	..
Albizzia sp. (Kalbagi)	..	..	..	..	1 11 6	..	0 10 0	0 15 9	..	..
Vitex altissima	..	..	..	..	1 10 5	..	1 0 9	0 11 0	..	..
Hopea parviflora	..	..	..	..	2 2 1	1 14 7	1 13 0	..	..	1 12 11
Xylia xylocarpa	..	..	..	..	1 14 5	1 3 10	1 1 2	11 4	..	1 2 11

Average rates realized in auction and by tender—cont.

B. Bunder Depot—*cont.*

Special and kind.	1920–21. RS. A. P.	1921–22. RS. A. P.	1922–23. RS. A. P.	1923–24. RS. A. P.	1924–25. RS. A. P.	1925–26. RS. A. P.	1926–27. RS. A. P.	1927–28. RS. A. P.	1928–29. RS. A. P.	1929–30. RS. A. P.
*Sleepers.**										
Hopea parviflora	..	..	..	..	..	..	..	..	..	..
Xylia xylocarpa	..	..	..	..	..	..	..	..	..	..
Terminalia tomentosa	..	..	..	..	..	..	..	..	..	..
Panels.										
Lagerstroemia lanceolata	..	..	..	..	..	..	..	..	..	..
Artocarpus hirsuta	..	..	..	..	2 0 0	2 3 7	2 0 11	2 6 5	..	1 12 0
Calophyllum tomentosum	..	..	..	..	..	..	1 10 2	..	..	1 11 0
Poles.										
Tectona grandis	..	..	..	..	..	0 10 9	..	..	..	..
Careya arborea	..	..	..	..	..	..	0 12 5	..	..	..
Miscellaneous.										
Rejected sleepers, Xylia	..	..	..	..	..	..	2 3 9	2 2 8	..	..
Rejected sleepers, Hopea	..	..	..	..	..	..	2 5 2	2 6 5	2 1 3	..

* Xylia.

	RS. A. P.		RS. A. P.
Broad gauge—		Metre gauge—	
I	8 0 0	I	3 0 0
II	5 5 0	II	2 0 0

Rate adopted uniformly

107. Current retail prices are furnished in the accompanying table :—

Rates at which timber is sold in retail in Bunder sale depot of Mangalore from 1*st April* 1930.

Species.	I grade. RS. A. P.	II grade. RS. A. P.	III grade. RS. A. P.	Not graded. RS. A. P.	Sawn timber, Rate per cubic foot. RS. A. P.
	Rate per cubic foot in the shape of logs.				
1 Teak (Tectona grandis)	2 8 0	2 0 0	1 8 0	..	3 8 0
2 Biti (Dalbergia latifolia)	2 8 0	2 0 0	1 8 0	..	3 4 0
3 Kiralbogi (Hopea parviflora)	1 12 0	1 10 0	1 6 0	..	2 4 0
4 Hebbalsu (Artocarpus hirsuta)	1 12 0	1 10 0	1 6 0	..	Vide items 18 to 20 below.
5 Banapu (Terminalia tomentosa)	1 8 0	1 6 0	1 4 0	..	2 2 0
6 Tirwa (Xylia xylocarpa)	1 6 0	1 4 0	1 0 0	..	2 2 0
7 Benteak (Lagerstroemia microcarpa)	1 4 0	1 2 0	1 0 0	..	2 0 0
8 Marwa (Terminalia paniculata)	1 2 0	1 0 0	0 14 0	..	1 14 0
9 Poon or Shreehonne (Calophyllum elatum)	..	..	..	1 12 0	2 8 0
10 Benga (Pterocarpus Marsupium)	..	..	..	1 8 0	..
11 Bilithirpu (Eugenia Gardneri)	..	..	..	1 0 0	..
12 Challa (Lagerstroemia Flos-Reginae)	..	..	..	1 0 0	..
13 Myrole (Vitex altissima)	..	..	..	1 0 0	..
14 Anavu (Adina cordifolia)	..	..	..	1 0 0	..
15 Teak poles 19″ to 30″ midgirth	..	..	..	1 0 0	..
16 Teak poles 11″ to 18″ midgirth	..	..	..	0 12 0	..
17 All other saleable species	..	..	..	0 14 0	..
18 Hebbalsu planks 9″ to 11″ wide	..	..	..	..	3 0 0
19 Hebbalsu planks 12″ to 18″	..	..	..	..	3 8 0
20 Hebbalsu planks above 18″	..	..	..	..	4 0 0

Note.—Description of the three grades—
Midgirth 60″ and over, minimum length 10′ is classed as I grade.
Midgirth 48″ to 59″ and minimum length 10′ is classed as II grade.
Remaining logs of smaller sizes up to a minimum girth of 31″ are classed as III grade.

Rates at which timber is sold in retail in Kasaragod sale depot of South Mangalore Division from 1*st April* 1930.

Species.	I grade. RS. A. P.	II grade. RS. A. P.	III grade. RS. A. P.	Not graded. RS. A. P.
	Rate per cubic foot in the shape of logs.			
1 Teak (Tectona grandis)	2 8 0	2 0 0	1 8 0	..
2 Biti (Dalbergia latifolia)	2 8 0	2 0 0	1 8 0	..
3 Kiralbogi (Hopea parviflora)	1 12 0	1 10 0	1 6 0	..
4 Hebbalsu (Artocarpus hirsuta)	1 12 0	1 10 0	1 6 0	..
5 Banapu (Terminalia tomentosa)	1 8 0	1 6 0	1 4 0	..
6 Tirwa (Xylia xylocarpa)	1 6 0	1 4 0	1 0 0	..
7 Benteak (Lagerstroemia microcarpa)	1 4 0	1 2 0	1 0 0	..
8 Marwa (Terminalia paniculata)	1 4 0	1 2 0	1 0 0	..
9 Poon or Shreehonne (Calophyllum elatum)	..	..	..	1 4 0
10 Benga (Pterocarpus Marsupium)	..	..	..	1 8 0
11 Bilithirpu (Eugenia Gardneri)	..	..	..	1 0 0
12 Challa (Lagerstroemia Flos-Reginae)	..	..	..	1 0 0
13 Myrole (Vitex altissima)	..	..	..	1 0 0
14 Anavu (Adina cordifolia)	..	..	..	1 0 0
15 Teak poles 19″ to 30″ midgrith	..	..	..	1 0 0
16 Teak poles 11″ to 18″ midgirth	..	..	..	0 12 0
17 All other saleable species	..	..	..	0 14 0

Note.— (i) Description of the three grades—
Midgirth 60″ and over, minimum length 10′ is classed as I grade.
Midgirth 48″ to 59″ and minimum length 10′ is classed as II grade.
Remaining logs of smaller sizes down to a minimum girth of 31″ are classed as III grade.
(ii) The rates shown above are for the Kasaragod sale depot at Kasaragod. Timber, however, can be sold to the public in all the forest and boating depots also, the rate being arrived at by deducting from these notified rates, the actual cost of transport from such depot to the sale depot at Kasaragod at the discretion of the District Forest Officer.

108. *Foreign markets.*—No developments in foreign markets are expected in the immediate future. A report by Mr. Master on the markets of Bombay and the West Coast ports, made in 1929, can be referred to for information.

SECTION 3.—LINES OF EXPORT.

109. River transport, either by rafting or boating, is used to the maximum extent possible. Rivers of South Kanara are not well adapted to this method and numerous shallows and rapids exist along their courses—

(*a*) Rafting of produce is possible along the Paiswani river from Sampaje for about 3½ months following the high floods of July, and from Parappa up to December. There are, however, insufficient raftsmen to deal with large quantities. The maximum quantity which can be rafted is about 15,000 cubic feet from Parappa, and about 12,000 cubic feet from Sampaje. If there are floods during the rafting period (July to December) rafting beyond Kudrechatal rapid is impossible, or unreliable. The cost of rafting from Sampaje is from 6 annas 9 pies to 7 annas per cubic foot, which effects about 2 annas saving over carting rates.

At the time of writing, rafting is severely limited by the dearth of bamboos consequent upon the dying back of this species after flowering in nearly all convenient localities, and the want will be felt for some years.

(*b*) Timber is conveyed to Mangalore by rafts or boats along the Netravati. During extraction from Porkala and Padnur reserves, timber was brought to the Government depot at Vollal by carts, thence rafted a distance of about 40 miles. Bamboos were collected by the contractor at his own cost, being allowed about 150 bamboos for every 100 cubic feet of logs rafted. The rafting rate from Vollal was 3 annas per cubic foot. Rafting or boating is possible for a short period above Vollal as far as the confluence of the Sisla Hole, but the river is beset by rapids. Floating operations from Dadanthamale reserve were estimated to cost 5 annas per cubic foot. Timber from Mujur coupes carted as far as Uppinangady is boated to Mangalore during the rains in country craft, and after the rains until the end of March in smaller boats. There is difficulty in securing sufficient boats as local Maplahs at Uppinangady do not own many. Boatmen complain moreover that their craft get damaged in the process. The method employed in loading is to sink the boat alongside the depot by stones while logs are brought and tied alongside, and subsequently to refloat them. Boats are also required by a local firm of paddy and grain exporters, and by the Nerankimale reserve fuel contractor. The quantities now extracted, i.e., about 25,000 c. ft. of logs and sawn timber, is probably close on the maximum possible.

(*c*) Produce, from Puttur Range which does not go to Kasaragod, is carted as far as Panemangalore about 16 miles upstream from Mangalore on the Netravati river, and thence boated to Bunder depot.

(*d*) The Nileshwar river will in due course be available for the transport of material in the Nileshwar-Panatady section of Kasaragod Range.

110. The principal lines of road export to depots are—

(*a*) *Kasaragod Range.*—(1) From Kolchar to Muroor by forest road, 8 miles (unmetalled), from Muroor to Kasaragod, by local fund road (metalled).

(2) From Jalsur to Kasaragod, by local fund road (metalled).

(3) From Sampaje to Jalsur via Mercara-Mangalore local fund trunk road (metalled); thence via (2) to Kasaragod.

(4) From Kandadka to Jalsur by local fund road (lightly metalled); thence via (2) to Kasaragod.

(5) Panatady to Hosdrug.

(*b*) *Puttur Range.*—(1) Sampaje to Mangalore metalled trunk road. Produce is generally boated from Panemangalore (15th mile).

(2) Kollamogaru and Baradka to Guttigar by unmetalled road; thence on the Subramanya-Jalsur local fund road (lightly metalled and in poor repair) via Karadka to Jalsur; thence to Kasaragod [(*a*) (2)] or to Mangalore [(*b*) (1)].

(3) Arampadi, Balpa and Panja via Padnur to Kandadka and Jalsur (lightly metalled), thence to Kasaragod, via [(*a*) (2)]; or (seasonal) to Puttur by local fund road (metalled) and Mangalore [(*b*) (1)]; or fording Kumradhari river north of Panja via Kadaba or Hosmet (ferry) to Uppinangady.

(*c*) *Uppinangady Range.*—(1) Mujur (Sunkadakatte) to Uppinangady—lightly metalled (One ferry at Hosmet), thence by Netravati river to Mangalore.

(2) Shirady and Managundi to Uppinangady, local fund road, metalled.

(*d*) *Beltangady Range.*—(1) Charmady and Beltangady to Bantwal by local fund metalled road; produce thence usually boated to Mangalore.

(2) Dharmastala to Beltangady by lightly metalled road, thence by [(*d*) (1)] to Bantwal.

111. The above are the principal routes from east to west leading to sea ports. Transverse communications north and south are invariably poor and comparatively few in number, but the majority of forest areas likely to be tapped are not more than 5 miles from existing fair-weather cart-tracks or roads in reasonable repair utilizable for export traffic. The lengthy rainy season and numerous unbridged streams, some permanently unfordable, others becoming temporarily so, are the principal obstacles rendering road transport difficult and costly; second and third class laterite roads also become extremely heavy and muddy from June to November. Partly for these reasons, the system of "advance fellings" has been in vogue in many parts of the district not immediately adjoining first-class metalled roads, it being desirable to extract produce in advance of the rains in order to cope with the requisite volume of material during the short season available. Timber is transported either direct to coastal depots or to intermediate depots (e.g., Uppinangady) for river transport during the rains.

112. Average carting rates in the division are 4 to 5 annas per mile depending on the nature of the load and condition of the roads. A slightly less rate is generally accepted for sleepers than logs. The average load is about 25 cubic feet. Timber carting is not as a rule so highly developed as in Malabar, Mysore and the Wynaad. Some difficulty is apt to be experienced during the coffee-export season from Mysore and Coorg, since cartmen can generally take return loads up-country and this work is generally more remunerative than timber. Local draught-bullocks are rather too light for timber transport, and the best bullocks come from Mysore. Local cartmen are also in many instances small cultivators and during crop seasons dismantle their carts and send their bullocks to Mysore and the higher country to graze.

With the recent fall in prices of coffee and other raw produce from above ghats, decreased buying on the coast and general trade depression, cartmen have evinced greater readiness to come for timber transport, even at reduced rates. At the time of writing there is no difficulty in securing cartmen.

Section 4.—Methods of Exploitation and their costs.

113. *Agency of exploitation.*—During the years 1915–18, timber cut from coupes near Shirady under the Timber Working Circle of the 1902 Plan was sold at stump site or road-side depots at a rate of 5 annas per cubic foot for all species. Similarly coupes III and IV of Parappa reserve in 1919–20 and 1920–21 were sold to Kasaragod contractors. Since then all works of exploitation in timber coupes have been undertaken by the Department. Rafting and boating are done by contract. Carting contractors are found from Kasaragod for transporting produce in Kasaragod and Puttur Ranges. A few Government carts were in use at Parappa up to the year 1929, but private carts are now in general employ in all ranges. Fuel coupes continue to be sold standing to purchasers.

114. *Marking for felling.*—Minimum girth limits have varied from time to time. Limits in vogue for selection fellings in natural forest have, during the past several years, been generally 5 feet in girth at breast height for all species except *Xylia*, which was felled at 4 feet 6 inches in girth. Marking in Parappa reserve during the period of maximum conversion was conducted down to minimum limits of 4 feet for teak, *Xylia xylocarpa*, *Lagerstroemia lanceolata*, and *Terminalia paniculata*; 4 feet 6 inches for *Pterocarpus Marsupium* and *Terminalia tomentosa*; and 5 feet at breast height for all other species. In 1926–27 after the installation of the sawmill at Parappa, girths were uniformly reduced to a minimum of 3 feet over bark at breast height, this being subsequently modified to 4 feet on hot southerly slopes. During the current year the minimum limit for *Xylia xylocarpa* has been reduced to 4 feet at breast height, owing to the unsatisfactory proportion of splitting in sawn material after conversion from higher girth classes. In clear-felling areas, all saleable species over 5 feet girth are marked, teak and rosewood to 3 feet girth, and *Xylia* to 4 feet girth. Selection is subsequently made of straight long poles of good species below these limits for local sale where there is demand for such. Marking is generally made by a forester under supervision and check by the Range Officer, and partially checked at times by a gazetted officer.

Estimated height and measured girth at breast height (or in the case of buttressed trees, above buttresses) are entered in the enumeration register. Trees are marked by a blaze at breast height and at the base, and given a serial number in tar.

115. *Felling.*—Felling is generally done by Malabar axemen. Trees are felled up-hill as far as possible, and, if over existing regeneration, with care to cause the minimum damage to seedlings.

116. *Logging and dragging.*—Logs are sawn by cross-cut saw. Trees which are mishapen, fluted, or partly hollow are roughly hewn and squared. Logs intended for sawing are not squared since irregularities disappear in sawing. Logs for conversion into sleepers

are sawn into suitable lengths to yield broad or metre gauge sleepers with minimum waste, usually double length, plus 1 foot or 15 inches spare ; logs are sawn to as great a length as possible, provided not more than 30 feet in length and ordinarily not less than 10 cubic feet in contents. Midgirth of all logs is measured after removing the bark at the measured centre. A forester is placed in charge of this work, and posts the felling register. Logs are brought to forest depots or sawing pits by elephants. Buffaloes are not now in use ; but were employed up to 1929–30 for dragging small logs in Porkala reserve. Drag-holes are not made, logs being drawn by chains and chokers placed at the butt-end. This at times imposes some strain on the dragging elephant, especially when the log is irregular, as there is a natural tendency for the irregular portion to roll undermost and for the under lip of the butt to dig into soil and vegetation. To remedy this, boatshaped ends are to be tried in the future to enable heavy logs to ride more easily over obstructions. This decreases the available length of the log a trifle. Logs for road transport are brought on to a transverse ramp with foreends up-tilted. Here again there is a tendency for excessive strain to be placed on the dragging elephant, unless the ramp is gradual. Logs on steep-hill slopes have been pushed lengthwise down the slopes by elephants with tolerable success, but there is a limit to the feasibility of this method. Extraction roads are constructed where possible to reduce the dragging lead in all coupes. In many reserves a hill side has to be negotiated and extraction of logs from the interior is not an easy matter, and requires forethought in the lay-out of drag-paths by the Ranger in charge.

117. *Sawing and conversion.*—Sawing is done at selected pits and rarely at stumpsite. As many logs of *Xylia* and *Hopea parviflora* as possible are converted into broad gauge sleepers, and the remainder to metre gauge. An extra end allowance of 6″ is made when sawing to allow for development of possible cracks. The ends of sleepers are bound with hoop-iron. Portions of logs unfit for sleepers are sawn into scantlings of various sections in common usage and of as long a length as possible. *Artocarpus hirsuta* logs are sawn into planks 1 inch thick and of a width from 8 inches up to 2 feet. The maximum width and length of plank is aimed at. All sawn timber is stacked on kalangis on level ground and kept under shade. Preferably this should be under the natural shade of the forest itself, but as often happens, saw pits are in open clearings, devoid of leaf-shade and the pandals erected to shield stacked timber afford but scanty protection to the sun's rays.

Xylia sleepers have shown a disconcertingly high proportion of rejections on account of splitting after conversion. The proportion has varied in different localities.

Hopea parviflora from the overmature forests of Aletti West has given considerable wastage (apart from actual unsoundness) owing to the development of pronounced ring-shakes which amount to complete " shelling out " of the inner wood, although when felled the log may look sound. A certain number of kolmarams and chattams in addition to sleepers are cut, but the cost of production and transport leaves practically no profit. Up to the year 1926–27 a small quantity of *Terminalia tomentosa* (*crenulata*) logs were sawn into sleepers, but the demand was limited. From Nalkur reserve scantlings from this species are sawn.

During the year 1929–30, 100 broad gauge and 100 metre gauge sleepers of *Eugenia Gardneri* were cut from the best logs of Aletti West reserve of Kasaragod Range to the order of the Forest Utilization Officer, Madras, and supplied to the South Indian Railway free of charge for test purposes. A small quantity of planks of white cedar of 2 inches and 2½ inches thickness were sawn in Aletti West in 1929–30. The sawn yield from 495 cubic feet of logs was 278 cubic feet.

118. The following table represents the results of sawing operations in the principal felling localities of the past few years.

The results of sawing operations in South Mangalore Division.

Locality.	Year.	Species.	Volume of logs utilized.	Outturn of sawn timber. Broad gauge sleepers.		Metre gauge sleepers.		Kolmarams, chattams, scantlings.	Total outturn.	Percentage of yield. Broad gauge sleepers.	Metre gauge sleepers.	Scantlings, etc.	Total.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
			C. FT.	NO.	C. FT.	NO.	C. FT.	C. FT.	C. FT.				
						KASARAGOD RANGE.							
Aletti, West ..	1928–29 ..	Hopea	15,744	2,685	8,833·7	575	930·1	1,651	11,414·8	56·2	5·9	10·5	72·6
		Calophyllum tomentosum.	507	..	..	..	..	323	323	..	..	63·8	63·8
Aletti, West ..	1929 30 ..	Hopea	29,502	2,771	9,176·5	747	1,210·2	4,919·1	15,305·8	31·2	4·05	16·7	52·0
		Eugenia Gardneri ..	1,013	110	361·9	110	178·2	..	540·1	35	17·6	..	52·6
		Dysoxylum malabaricum.	495	..	..	..	..	277·6	277·6	..	..	56	56
						PUTTUR RANGE.							
Nalkur reserved forest.	1926–27 ..	Hopea parviflora ..	8,775	990	3,257·1	758	1,220·4	1,273·6	5,751·1	37·1	13·9	14·5	65·5
		Terminalia tomentosa.	4,895	517	1,700·9	..	..	789	2,490·0	34·8	..	16·1	50·9
		Artocarpus hirsuta ..	1,949	..	..	..	..	839·6	839·6	..	..	43	43
Nalkur reserved forest.	1928–29 ..	Hopea parviflora ..	15,063	1,890	5,896·8	917	1,375·5	2,169·1	9,441·4	39·2	9·1	14·4	62·7
		Terminalia tomentosa ..	1,043	..	..	..	..	664·8	664·8	..	..	63·7	63·7
		Xylia xylocarpa ..	3,721	448	1,435·3	302	475·2	456·7	2,367·2	38·6	12·8	12·3	63·7
		Calophyllum tomentosum.	1,295	..	..	..	..	919·5	919·5	..	..	71	71
Nalkur reserved forest.	1929–30 ..	Artocarpus hirsuta ..	380	..	..	..	..	189·1	189·1	..	..	49·75	49·75
		Hopea parviflora ..	8,532	1,390	4,573	500	810·1	1,320	6,703·1	53·7	9·5	15·5	78·7
		Xylia xylocarpa ..	2,950	250	8,225	71	115	747·3	9,087·3	27·9	3·9	25·4	57·2
		Terminalia tomentosa ..	2,166	..	..	..	..	1,469·8	1,469·8	..	..	67·9	67·9
		Artocarpus hirsuta ..	1,082	..	..	..	..	5,744	5,744	..	..	53·1	53·1
Sampaje reserved forest.	1928–29 ..	Xylia xylocarpa ..	4,561	511	1,681·9	514	832·7	617·35	3,632·0	37	18·4	13·5	68·9
						UPPINANGADY RANGE.							
Padnur Coupe I.	1926–27 ..	Terminalia tomentosa ..	4,360	574	1,888	..	..	887	2,775	43·3	..	20·3	63·6
		Xylia xylocarpa ..	1,159	77	253	108	174	271	698	21·9	15·0	23·7	60·6
Porkala Coupe I.	1927–28 ..	Terminalia tomentosa ..	81	13	42·8	..	..	7·3	50·1	52·8	..	9	61·8
		Xylia xylocarpa ..	4,979	388	1,274	481	770·8	835·6	2,880·6	25·6	15·5	16·8	57·9
Porkala Coupe II.	1928–29 ..	Xylia xylocarpa ..	4,170	263	865·3	641	1,032	438·2	2,535·4	20·7	24·7	10·5	55·9
Porkala Coupe III.	1929–30 ..	Xylia xylocarpa ..	3,015	139	457·3	324	524·9	317·9	1,400·1	15·1	17·3	10·5	42·9

119. The number of sleepers passed and rejected by the Forest Utilization Officer is given below for the year 1929–30.

Locality.	Species.	Number presented.		Number passed.				Number rejected.	
				First class		Second class.			
		Broad gauge.	Metre gauge.	Broad gauge.	Metre gauge.	Broad gauge.	Metre gauge.	Broad gauge.	Metre gauge.
Nalkur	Hopea ..	1,265	445	981	348	73	41	211	56
	Xylia ..	200	54	84	31	24	2	92	21
Porkala	Xylia ..	139	324	118	283	6	7	15	34
Aletti, West, 1928-29, 1929-30.	Hopea ..	2,646	553	2,091	411	130	43	425	99
Mujur, 1930–31	Xylia ..	29	1,054	25	892	..	..	4	162

120. *Removal of sawn material.*—It has been found convenient to employ manual labour for removing sawn material from saw settings to extraction roads. Coolies are paid at a rate of one and a half to three annas per broad gauge sleeper or its equivalent, according to lead.

121. *Costs of exploitation.*—The cost of the various items involved have not varied widely in different parts of the division within recent years. A slight reduction of rates has generally been achieved after the first year or two of opening up a fresh felling locality. The rates of felling, dragging or sawing compare reasonably and sometimes favourably with those of other districts, but the major charges are invariably those of transport, which in addition to initial charges of production do not leave as a rule a very appreciable margin of profit after deduction of overhead expenses and other incidentals, except in the Railway sleeper trade. There is no reason to anticipate any considerable permanent divergence from existing rates in the near future. It is unnecessary to enter into separate details of costs in each range, since the principal factors leading to alteration of rates, viz., distance and comparative remoteness from markets, amenities for labour, feeder roads to tap separate coupes, condition of the forests themselves, facilities for water-transport, etc., are not unique for any range, and vary from coupe to coupe. The principal matters in which care has to be exercised in future, assuming that sale prices remain fairly constant, are—

(1) The reaching of a maximum critical distance from markets. This applies to remote parts of Kiribag, Kilarmale, Shiradi-Sisla localities, etc.

(2) The tapping of unremunerative forests, which although possibly containing many good timber species, support only a sparsely-distributed crop of one or two first-grade timber species (e.g., teak, Hopea, *Artocarpus*, *Dalbergia*, or *Xylia*) which alone remain saleable at a profit after conversion and transport to market ; or, in other words, the progressive decrease in the intensity with which a forest can be worked owing to the elimination of the major portion of the crop as unremunerative, thus leading to proportionately heavier charges for preparation and collection of produce within the coupe itself, and an automatic enhancement of " overhead " expenditure per cubic foot on the produce actually realized. This affects Yenekal, Nalkur, Kombar, Mujur reserves, and the foothill country generally.

(3) Difficulties of topography, rendering necessary the substitution of manual labour for elephant and cart-haulage over considerable distances. Up to the present, dragging or carrying by manual labour has not been necessary, but might become necessary in evergreen forests of the ghat regions, e.g., Bagimale, Sampaje, Bantamale localities, etc.

122. The following brief notes are added, regarding specific charges on individual items :—

(*a*) *Felling.*—The almost universal rate allowed for felling and logging is 6 pies per cubic foot for round logs and 10 pies per cubic foot for squared logs. In case of tapping overmature and largely unsound forests an enhancement of rate is allowed and 1 anna per cubic foot of sound timber is paid for felling partially unsound trees.

(*b*) *Dragging.*—The charges for dragging by Government elephants and buffaloes, allowing for feed, maintenance, staff, sickness and upkeep of harness, etc., has been worked out and is appended to this section. The charges in specific coupes have varied according to topography and lead. The cost, for instance, in two Sampaje coupes of 1928–29 and 1929–30 has varied from Re. 0–1–5 to Re. 0–1–3 per cubic foot respectively

Abstract of cost of dragging by elephants.

Quarter ending.	Quantity dragged.	Cost of feed and upkeep.	Depreciation at 5 per cent on book value.	Interest at 6 per cent on book value.	Total.
	C. FT.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
In 1928–29—					
20th June 1928	17,417	1,320 14 0	150 8 0	180 9 0	1,651 15 0
20th September 1928 ..	36,709	2,430 4 0	265 4 0	318 1 0	3,013 9 0
20th December 1928	53,965	2,950 0 0	265 10 0	318 13 0	3,534 7 0
31st March 1929	46,238	3,133 15 0	325 3 0	390 1 0	3,849 3 0
	154,329	**9,835 1 0**	**1,006 9 0**	**1,207 8 0**	**12,049 2 0**

		RS. A. P.
Number of working days in the quarter for all the elephants		2,865
Number of days on which dragging was done		1,428
Proportionate cost towards dragging	12,049–2–0 × 1,428 / 2,865	6,005 9 0
Cost of medicine		34 10 0
Proportionate cost for the Inspector of Livestock		556 5 0
Other special items		887 0 6
	Total ..	**7,483 8 6**
Cost of dragging per cubic foot		0 0 9
If the entire cost of maintenance is debited towards dragging timber the cost per cubic foot dragged is		0 1 5

Quarter ending.	Quantity dragged.	Cost of feed and upkeep.	Depreciation at 5 per cent on book value.	Interest at 6 per cent on book value.	Total.
In 1929–30—					
20th June 1929	27,210	2,581 0 3	266 4 0	319 8 0	3,166 12 3
20th September 1929 ..	42,958	2,759 15 1	302 5 0	363 0 0	3,425 4 1
20th December 1929	35,902	2,782 5 4	298 15 5	355 1 8	3,436 6 5
31st March 1929	55,555	3,575 15 3	378 0 0	453 6 0	4,407 5 3
	161,625	**11,699 3 11**	**1,245 8 5**	**1,490 15 8**	**14,435 12 0**

		RS. A. P.
Cost (obtained for period in which dragging was done) apportioned to dragging timber		6,926 11 11
Cost of medicine		51 15 0
Proportionate cost for Inspector of Livestock		671 4 0
Special expenses		846 2 6
	Total ..	**8,496 1 5**
Cost of dragging per cubic foot		0 0 10
If the entire cost of maintenance is debited towards dragging timber the cost per cubic foot dragged is		0 1 7

Abstract of cost of dragging by buffaloes in 1929–30.

Quarter ending	Number of days in quarter.	Days on which actually dragged.	Quantity dragged.	Cost of feed and upkeep.	Deprecia-tion at 5 per cent on book value.	Interest at 6 per cent on book value.	Total.
			C. FT.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
20th June 1929 ..	486	220	6,903	849 6 1	17 3 0	20 8 0	887 1 1
20th September 1929.	552	338	15,069	946 9 3	19 10 2	23 6 0	989 9 5
20th December 1929.	455	153	4,643	889 12 1	15 1 8	18 1 11	922 15 8
31st March 1929 ..	251	155	3,507	515 15 0	7 4 0	8 12 0	531 15 0
Total ..	**1,744**	**866**	**30,122**	**3,201 10 5**	**59 2 10**	**70 11 11**	**3,331 9 2**
Add—Cost of medicine, share of Inspector of Livestock, and other expenses							249 7 0
Grand total							**3,581 0 2**
Proportionate cost of dragging per cubic foot							0 0 11
Total cost of dragging per cubic foot							**0 1 11**

(c) *Rafting*—

From Sampaje locality—Re. 0–7–0 to 0–8–0 per cubic foot.

From Parappa locality—Re. 0–3–0 per cubic foot.

Raft-holes are cut at 1 anna per log.

(*d*) *Sawing*.—Past average rates are—

Species.	Broad gauge sleepers each.	Metre gauge sleepers each.	Kolmarams each.	Chattams each.	Scantlings per cubic foot.
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
Xylia xylocarpa	1 4 6 to 1 5 0	0 10 6 to 0 11 0	..	..	0 7 0
Hopea parviflora	1 4 0 to 1 6 0	0 10 0	1 0 0 to 1 1 3	0 8 0	0 6 6 to 0 7 0

The higher rates are generally paid for sawing in partially unsound or overmature timber. Sawing longitudinal cuts in Poon (*Calophyllum elatum*) and other species is paid at the rate of 3 annas per square foot of cut surface. Scantlings were formerly paid for at the rate of Rs. 30 per 'kody' (i.e., 120 cubic feet).

(*e*) *Carting*.—The following rates have been paid, which included toll-gate charges :—

Kasaragod Range—

From Kolchar to Kasaragod—37½ miles.

Rs. 1–6–6 per broad gauge sleeper.

Re. 0–12–0 per metre gauge sleeper.

Re. 0–7–3 per cubic foot of scantlings.

From Parappa to Kasaragod—27 miles—

Re. 0–4–6 per cubic foot of logs.

From Sampaje to Kasaragod—48 miles—

Re. 0–8–8 per cubic foot of sleepers.

From Sampaje to Panemangalur—50 miles—

Re. 0–8–8 per cubic foot of scantlings.

Puttur Range—

From Baradka to Kasaragod—53 miles—

Re. 0–11–0 per cubic foot of sleepers.

From Baradka to Panemangalur—53 miles.

Re. 0–11–0 per cubic foot of scantlings.

Uppinangady Range—

From Mannagundi (Porkala-Padnur coupes) to Vollal—7 miles—

Re. 0–2–6 to Re. 0–2–9 per cubic foot of logs.

From Sunkadakatte to Uppinangady—24 miles—

Re. 0–5–3 per cubic foot of logs.

Re. 0–5–0 per cubic foot of sleepers and sawn material.

From Shirady to Bantwal—37 miles—

Re. 0–7–0 per cubic foot of logs.

(*f*) *Boating*.—

From Uppinangady to Mangalore—31 miles—

Re. 0–3–0 per cubic foot of log ;

Re. 0–2–9 per cubic foot of sawn material.

From Panemangalur to Mangalore—16 miles—

Re. 0–1–6 per cubic foot of sawn material.

Statement showing the cost of production and delivery of sleepers or scantlings.

A. Items common to all localities.

Particulars.	Scantling per cubic foot.	Cost per broad gauge.	Cost per metre gauge.
	RS. A. P.	RS. A. P.	RS. A. P.
1 Felling at 5 pies per cubic foot	0 0 7	0 2 1	0 0 11
2 Dragging at As. 1–5 per cubic foot	0 2 0	0 6 7	0 3 1
3 Sawing (old average rates)	0 7 0	1 4 6	0 10 6
4 Cutting and binding ends	..	0 5 0	0 2 6
5 Sheds for sawyers and subordinates (averages).	..	0 1 8	0 0 9
Total ..	**0 9 7**	**2 3 10**	**1 1 9**

B. Transport.

Locality.	Scantling per cubic foot.	Cost per broad gauge.	Cost per metre gauge.
	RS. A. P.	RS. A. P.	RS. A. P.
Sampaje	0 8 0	1 10 0	0 12 0
Nalkur	0 10 0	2 0 6	0 15 0
Bantamale	0 13 0	2 2 5	1 2 0
Mujur	0 7 0	1 9 3	.

Statement showing the cost of production and delivery of sleepers or scantlings—cont.

C. Cost of production and delivery.

Locality.	Scantling per cubic foot.	Cost per broad gauge.	Cost per metre gauge.
Sampaje	1 1 7	3 13 10	1 13 9
Nalkur	1 3 7	4 4 4	2 0 9
Bantamale	1 6 7	4 6 3	2 3 9
Mujur	1 1 4	3 13 1	1 13 4

123. *Recent reductions owing to reduced cost of living.*—The following reductions have now been made in labour charges for the year 1931–32, owing to reduced cost of living :—

	Old rate. RS. A. P.	Reduced rate. RS. A. P.
Kasaragod Range—		
Cooly wage	0 8 0	0 6 0
Sawing rate—broad gauge sleeper	1 4 0	1 0 0
,, metre gauge sleeper	0 10 0	0 8 0
Felling rate per cubic foot	0 0 6	0 0 5
Puttur Range—		
Cooly wage	0 8 0	0 6 0
Sawing rate—broad gauge sleeper	1 4 0	1 0 0
,, metre gauge sleeper	0 10 0	0 8 0
Felling rate per cubic foot	0 0 6	0 0 5
Carting Nalkur timber	0 10 0	0 9 0
Floating	0 6 9	0 6 3
Carting from Sampaje to Kasaragod	0 8 0	0 7 6
Uppinangady Range—		
Sawing rate—broad gauge sleeper	1 5 0	1 0 0
,, metre gauge sleeper	0 10 6	0 8 0
Carting logs from Mujur to Uppinangady	0 5 3	0 4 6
Carting sawn timber from Mujur to Uppinangady.	0 5 0	0 4 0
Felling rate per cubic foot	0 0 6	0 0 5

124. *Removal of timber by right and privilege holders.*—In the case of right holders the method of valuation prior to 1927–28 was to adopt an all-round rate of 4 annas per cubic foot for purpose of simplicity in reckoning. The correct method of valuation, i.e., to value cubical contents at different seigniorage rates, has thereafter been used.

Produce shown as given to right and privilege holders is timber of reserved and classified species given free from kumaki lands on application for 8 *bona fide* domestic and agricultural purposes for the kumkidars. Calculations are based on actual girth-measurements recorded by tahsildars. All applications are enquired into by revenue officers, but orders are passed by the District Forest Officers, except in cases where timber removed from one village is to be utilized in another, wherein the permission of the Collector is sought. Unclassified species are removable by ryots from unreserves without restriction, provided they are utilized for their own domestic purposes.

125. *The Parappa Saw Mill.*—Mention is made in paragraphs 196, 197, of the reasons adduced for the inception of a light saw mill in the division, its location in February 1927 at Parappa instead of at Baradka, and its final closing down in March 1930.

During the period, the following quantities were actually sawn at the mill :—

	C. FT.
1926–27 (February-March)	7,504
1927–28	64,683
1928–29	82,618
1929–30	87,004
Total	**2,41,809**

The percentages of sawn yield varied from 42·8 per cent in 1927–28 to 46·7 per cent in 1928–29 and to 58·6 per cent in 1929–30. Sawing charges including direct costs, depreciation, overheads and interest on capital, were reduced from As. 15-9·36 in 1927–28 to annas 11 in 1929–30. The mill was efficiently run, and working improved consistently during the period. It is unnecessary here to enter in great detail into the statistics worked out at exhaustive length and available in the letter from the Conservator, VI Circle, to the Chief Conservator of Forests, No. A. 1167/29, dated 24th September 1929. Some tables are however appended to this section, showing the general results of working. In this

letter the Conservator effectively showed that the results of sales of logs only at Kasaragod depot before the saw mill was in existence, based on averages for the three previous years (1924–27) showed a better profit than by the disposal of sawn produce. Comparison was complicated owing to the additional overheads chargeable on account of Chief Forest Engineer, Forest Engineer, and Forest Utilization Officer, by selling agent's commission, and by the additional cost of handling sawn material at depot. These comparative figures are given in the statement appended. It shows that, for species other than teak, a net loss was deducible even under the most favourable circumstances of consideration, whereas by log sales a margin of profit was always obtainable. The Conservator (Mr. Madan) therefore reported that :—" The conversion by means of a saw mill of non-teak species must therefore be considered a failure and must be abandoned as not practicable at least in South Kanara." No more favourable situation than Parappa was possible, with the added disadvantage that neither Sampaje nor Mujur localities were able to supply a high proportion of teak, this species being entirely absent in the latter reserve. The mill was closed down and handed over to the District Forest Officer on 31st March 1930.

126. *Statement showing the cost of production of timber supplied to the Saw Mill at Parappa during* 1928–29—

Details.		Cost.	Rate per cubic foot.
	RS. A. P.	RS. A. P.	RS. A. P.
1 *Felling and conversion of logs based on the actuals for the year* (89,294 *cubic feet*)		3,263 9 0	0 0 7·02
2 *Dragging*—			
(*a*) Cost of feed and keep of elephants and buffaloes engaged in dragging timber intended for saw mill alone—Quantity actually dragged in the year being 89,379 cubic feet ..		7,046 0 0	
(*b*) Depreciation on the cost of livestock engaged in dragging saw mill timber		431 0 0	
(*c*) Repairs to elephant sheds		174 0 0	
(*d*) Proportionate cost of iron cooking vessels, etc.		51 4 0	
(*e*) (i) Renewing and repairs to elephant gear (for the whole division)	650 6 0		
(ii) Renewing and repairs to hobbles and drag chains (for the whole division).	178 0 0		
(iii) Cost of medicines (for the whole division)	48 0 0		
(iv) Share of Livestock Inspector (for the whole division)	723 3 0		
Total ..	**1,599 9 0**		
Proportionate cost on timber supplied to the saw mill $\frac{1,599\text{-}9\text{-}0 \times 6\frac{1}{2}}{13 \text{ (elephant units)}}$		799 12 0	
(*f*) Pay and Fixed Travelling Allowance of Livestock Forester based on the total timber extracted at Parappa to the quantity supplied to the Mill—			
Pay		312 0 0	
Fixed Travelling Allowance		104 0 0	
Total cost of dragging 89,379 cubic feet ..		**8,918 0 0**	
Cost of dragging per cubic foot $\frac{8,918}{89,379 \text{ cubic feet}}$		..	0 1 7·20
3 *Carting*—			
(*a*) Actual expenditure incurred in carting 88,393 cubic feet (including cost of feed and keep of buffaloes engaged in carting)		8,819 0 0	
(*b*) 5 per cent of capital cost (viz., 1,510) of new extraction road.		75 0 0	
(*c*) Repairs to extraction road		50 4 0	
(*d*) One-third cost of Government carts		125 0 0	
Total cost of carting 88,393 cubic feet of timber.		**9,069 4 0**	
Cost of carting per cubic foot $\frac{9,069\text{-}4\text{-}0}{88,393 \text{ cubic feet}}$		..	0 1 7·70

Statement showing the cost of production of timber supplied to the Saw Mill at Parappa during 1928–29—cont.

Details.	Cost.			Rate per cubic foot.		
	RS.	A.	P.	RS.	A.	
4 *Miscellaneous*—						
(*a*) Share of Working Plan $\frac{89,294 \text{ cubic feet} \times 1,547}{4,60,000 \text{ cubic feet}}$	297	0	0			
(*b*) Range establishment (executive and clerical)—						
(i) One Forester in charge of felling for one year—						
Pay	360	0	0			
Fixed Travelling Allowance	120	0	0			
(ii) Pay of IV grade Forest Guard for one year	180	0	0			
(iii) One Forester in charge of carting—						
Pay foı nine months	360	0	0			
Fixed Travelling Allowance	90	0	0			
(iv) Pay of a Forest Guard in charge of carting for nine months	135	0	0			
(v) Pay of a V grade Ranger for four months	500	0	0			
(vi) Pay of two Range clerks for four months	260	0	0			
(vii) Pay of a Range peon for four months	52	0	0			
(viii) Travelling allowance of range clerks and peons for four months	82	0	0			
(ix) Travelling allowance of a V grade Ranger for three months	162	0	0			
(*c*) District Forest Officer and his Assistants and Establishment—						
(i) Pay of District Forest Officer and two Assistant Conservators for two months	2,737	0	0			
(ii) Office clerks—Pay for two months	699	0	0			
(iii) Pay of peons for two months	104	0	0			
(iv) Tıavelling allowance of District Forest Officer and Assistant Conservators for two months	726	0	0			
(v) Travelling allowance of clerks and peons for two months.	87	0	0			
(*d*) Share of Conservator and Chief Conservator	1,305	0	0			
(*e*) Leave and pension contribution :—						
(i) 30 per cent of Imperial Service men (including Conservator and Chief Conservator)	839	0	0			
(ii) 25 per cent of superior service men	934	0	0			
(iii) One-sixteenth of inferior service men	29	0	0			
(*f*) Interest on capital, Rs. 7,521–3–4 at 5 per cent	376	0	0			
(*g*) Depreciation on buildings at 2½ per cent	188	0	0			
(*h*) Repairs and renewals of buildings (actuals)	80	0	0			
(*i*) Fire-protection (actuals)	20	0	0			
Total cost on 89,294 cubic feet ..	10,722	0	0			
Cost of miscellaneous charges, per cubic foot $\frac{10,722}{89,294 \text{ cubic fee}}$	..			0	1	11
Total ..				0	5	9

127. *Explanatory notes on the above items.*—(1) *Felling.*—This was based on actual expenditure incurred in felling and logging 89,294 cubic feet of timber, including all incidentals.

(2) *Dragging.*—(*a*) The actual cost of feed and keep of elephants and buffaloes was worked out from the livestock returns.

(*b*) Depreciation on elephants has been fixed at 2 per cent by the Chief Conservator of Forests in his L. Dis. No. 8932/27, dated 13th August 1928, but actually 4 per cent was allowed, and for buffaloes 10 per cent.

(*c*) For iron cooking vessels one-sixth of new vessels plus a proportion for the old vessels used was charged.

(*d*) Repairs and renewals were estimated on the number of "elephant units" actually employed during 1928–29 for the mill at Parappa, assuming ten months to be the maximum working period in the year. For purposes of calculation two pairs of buffaloes were taken as the equivalent of one elephant. The total expenditure on these items for the whole division was proportionately allotted.

(3) *Carting.*—The total quantity carted during the year was 88,393 cubic feet. The actual expenditure was Rs. 8,678–4–0. To this is added the cost ot maintenance of Government buffaloes employed in Government carts, viz., Rs. 140–12–0.

(4) *Miscellaneous*—(*a*) *Cost of Working Plan.*—This refers to cost of enumerations carried out specially for the mill, the total quantity enumerated being 460,000 cubic feet. The cost was proportionately allotted.

(*b*) & (*c*).—Pay and Travelling Allowances of Staff were worked out approximately for the time actually spent in connection with timber supply at Parappa.

(*d*) *Share of Conservator and Chief Conservator.*—Total expenditure for Chief Conservator and establishment as per 1928–29 revised budget was divided by the number of Forest Divisions in the Presidency, i.e., by 28. Similarly, total expenditure for the Conservator was divided by 6, being the number of divisions in the Circle. One quarter of the total expenditure was charged to Exploitation (Chief Conservator's No. 4234/29-C-3, dated 28th July 1929). The total quantity of timber exploited departmentally in Mangalore South Division was 209,000 cubic feet and quantity supplied from Parappa was 91,000. The proportionate cost was Rs. 1,305.

(*e*) *Leave and pension contribution.*—The percentages adopted were those communicated by Messrs. Fraser & Ross—vide Chief Conservator's L. Dis. No. 9685/26, dated 12th January 1927.

(*f*) *Interest on capital.*—Five per cent of capital cost of buildings has been taken into account.

(*g*) *Depreciation on buildings.*—This was calculated at 2½ per cent as per G.O. No. 1941, Development, dated 13th November 1924.

128. *Parappa Saw Mill.*—

Comparative statement showing cost of production at Kasaragod depot per cubic foot of mill-sawn timber with profit or loss in 1928--29, *and results of log sales by the division in the three previous years* (1923–26).

Particulars.	Mill-sawn timber handled by Forest Engineer and Forest Utilization Officer. — Cost of production per cubic foot. — Net cost of production at depot, excluding all overheads and agents' commission.	Cost, with overheads but excluding agents' charges.	Cost, including depot expenses and agents' charges, but excluding overheads.	Inclusive of all charges, showing maximum cost of production.	Revenue obtained per cubic foot.	Profit or loss per cubic foot. Figures in italics denote loss. — Columns (2) and (6).	Columns (3) and (6).	Columns (4) and (6).	Columns (5) and (6).	Logs handled by the district in the years 1923–26. — Cost of production per cubic foot of log.	Revenue per cubic foot of log.	Profit per cubic foot of log.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
(i) For all species including teak—												
(*a*) per cubic foot of sawn timber ..	1 13 0·4	2 1 1·5	2 1 5·9	2 5 7·0	2 2 10·7	0 5 10·3	0 1 9·2	0 1 4·8	*0 2 8·3*	0 9 3	1 2 0·2	0 8 9·2
(*b*) per cubic foot of log sawn ..	0 13 6·8	0 15 5·7	0 15 7·8	1 1 6·7	1 0 3·6	0 2 8·8	0 0 9·9	0 0 7·8	*0 1 3·1*			
(ii) For species other than teak—												
(*a*) per cubic foot of sawn timber ..	1 13 0	2 1 1·0	2 1 5·5	2 5 6·5	1 5 7·7	*0 7 4·3*	*0 11 5·3*	*0 11 9·8*	*0 15 10·8*	0 9 3	0 12 11·1	0 3 8·1
(*b*) per cubic foot of log sawn ..	0 13 2·7	0 15 1·0	0 15 3·7	1 1 2·0	0 9 10·4	*0 3 4·3*	*0 5 2·6*	*0 5 5·3*	*0 7 3·6*			

129. *Analysis of costs of production of logs and sawn timber from Nalkur Reserved Forest*—

Statement showing the cost of production of timber extracted during the years 1924–25 *to* 1930–31.

Details.	Total amount. RS.	A.	P.	Rate per cubic foot. RS.	A.	P.
1 *Felling and conversion of logs based on actuals*—The total quantity of logs extracted in the whole of coupe I during the last six years is 98,199 cubic feet	3,093	13	5	0	0	6·05
2 *Dragging*—Actuals worked out on the basis adopted for working out similar details for Parappa Reserved Forest in 1928–29 and 1929–30, taking into account all incidental charges ..	..			0	1	5
3 *Carting*—(*a*) Actual expenditure incurred on carting. Sawn timber carted during the last six years is 51,270·63 cubic feet, including sleepers	37,088	1	4			
(*b*) Whole of the capital cost of the Nalkur extraction road constructed in the years 1926–27 to 1930–31	5,363	8	0			
(*c*) Repairs to roads and bridges	637	12	0			
(*d*) For transport of sawn materials from sawpits to coupe roads and stacking the same	688	14	6			
Total cost on 51,270·63 cubic feet of sawn timber ..	**43,778**	**3**	**10**	**0**	**13**	**8·2**
4. *Sawing*—(*a*) The quantity sawn during the last six years in the whole of coupe I of Nalkur is 55,423·11 cubic feet and the cost thereon is	25,309	3	0			
(*b*) Incidental charges for putting up scaffolds, sawpits and sawyers' sheds, etc.	1,595	3	6			
Total cost on 55,423·11 cubic feet ..	**26,904**	**6**	**6**	**0**	**7**	**9·2**
5 *Miscellaneous*—(i) Share of working plan—Details of the amount spent for logging survey is not available	..					
(ii) Cost of marking trees for felling by the divisional staff.	60	0	0			
(iii) Range establishment (executive and clerical)—						
Pay and Fixed Travelling Allowance of one Forester for six years at Rs. 40 per mensem	2,880	0	0			
Unhealthy tract allowance, 1927–30, at Rs. 10 per mensem.	480	0	0			
Enhanced Fixed Travelling Allowance, 1929–30, at Rs. 5 per mensem	120	0	0			
Pay of a IV grade special duty Forest Guard at Rs. 15 per mensem	1,080	0	0			
Unhealthy tract allowance for five years at Rs. 3 per mensem	180	0	0			
Pay of a watcher at Rs. 11 per mensem for six years ..	792	0	0			
Pay of a VI Grade Ranger for two years at Rs. 100 per mensem for six months in the year	1,200	0	0			
Pay of a VI Grade Ranger for three years at Rs. 100 per mensem for four months in the year	1,200	0	0			
Pay of Assistant Conservator-in-charge (one-third) for twelve months	1,500	0	0			
Travelling allowance of the Range Officer for 75 days in a year at Rs. 1–8–0 per day for five years	562	8	0			
Travelling allowance of Assistant Conservator for one year at 75 days in a year at Rs. 4 per day	300	0	0			
Pay of Range clerk for six months in a year for three years and three months in a year for another three years at Rs. 35 per month	750	0	0			
Pay of Range peon (one-third) for six years	288	0	0			
Travelling allowance of Range clerk taken for Timber depot inspection (lump sum)	120	0	0			
Travelling allowance of a peon, 75 days in a year at 6 annas for six years	162	12	0			
(iv) District Forest Officer and his establishment—						
(*a*) Pay of the District Forest Officer and two Assistant Conservators for one month in a year on the basis taken for Parappa Saw Mill	8,315	5	0			
(*b*) Travelling allowance of the District Forest Officer and Assistants for ten days in a year at Rs. 6 on an average, plus mileage	660	0	0			

Statement showing the cost of production of timber extracted during the years 1924--25 *to* 1930--31—cont.

Details.	Total amount. RS. A. P.	Rate per cubic foot. RS. A. P.
(c) Pay of District Forest Officer's clerk for one month in a year	3,600 0 0	
(d) Travelling allowance of tour clerk at Rs. 25 in a year for six years	150 0 0	
(e) Travelling allowance of peon, ten days in a year at 6 annas for six years	22 8 0	
Share of Conservator and Chief Conservator worked out on the basis for Parappa Saw Mill	399 0 0	
Pay of Bunder depot-keeper and watcher for six months in a year for six years	1,404 0 0	
(v) Interest on capital—		
Five per cent of the capital cost of buildings	172 0 0	
(vi) Details of buildings, etc.—		
(1) Wooden granary at Baradka	340 0 0	
(2) Rest-house at Baradka	1,913 12 0	
(3) Well at Baradka	390 0 0	
(4) Forester's quarters and forest guard's shed	209 0 0	
	3,452 12 0	
Depreciation on value of buildings at 2½ per cent	86 0 0	
Repairs and renewals to buildings (actuals)	529 12 6	
(vii) Fire-protection—		
The actuals for fire-protection for the whole of Nalkur Reserved Forest are Rs. 784–14–0. One-half the total is debited to "coupe 1."	392 7 0	
Total cost on 98,199 cubic feet ..	27,406 4 6	
Total cost per cubic foot	..	0 4 5·4

Abstracts of costs.

(*a*) *Logs*—

	RS.	A.	P.
Felling	0	0	6·50
Dragging..	0	1	5·00
Carting	0	13	8·17
Miscellaneous	*0	4	5·40
Total ..	1	4	1·07 per cubic foot.

* *Note.*—The cost of production of logs either at Kasaragod or Bunder depot shown above is Re. 1–4–1·07 per cubic foot. The rate per cubic foot under "Miscellaneous" is Re. 0–4–5·40. This is worked out with reference to sawn materials only, as timber in the shape of logs has not been transported to the sale depot during the last six years. Considering this, only half the rate of Re. 0–4–5·4 arrived at under "Miscellaneous" should be charged to logs. Thus the true cost of production per cubic foot of log is Re. 1–1–10·37.

(*b*) *Sawn material*—

	RS.	A.	P.
Felling	0	0	10·04
Dragging	0	2	4·22
Sawing	0	7	9·20
Carting	0	13	8·17
Miscellaneous	0	4	5·40
Total per cubic foot ..	**1**	**13**	**1·03**

The above figures are based on the assumption that sawn yield equals 60 per cent of log yield.

CHAPTER IV.—STAFF AND LABOUR SUPPLY.

Section 1.—Staff.

130. The present establishment of the South Mangalore Division is as follows :—

(a) *Headquarters staff*—

One District Forest Officer.
One Assistant Conservator of Forests.
Two clerks on time-scale of Rs. 60—4—80, i.e., one head clerk and one accountant.
Four clerks on time-scale of Rs. 35—1½—50—1—60.
One typist on time-scale of Rs. 35—1½—50—1—60.
One draughtsman on time-scale of Rs. 35—1½—50—1—60.
Four peons.
One depot-watcher.
One timber-watcher.

(b) *Range establishments.*—

Serial number and designation.	Kasaragod Range.	Puttur Range.	Uppinangady Range.	Beltangady Range.
1 Range Officer	1	1	1	1
2 Assistant Range Officer	1	1	..	..
3 Foresters	8	3	2	1
4 Forest guards	28	14	9	6
5 Reserve watchers	4	5	..	..
6 Timber watchers	..	..	1	..
7 Range clerks	2	1	1	1
8 Peons	1	1	1	1

131. The establishment shown in the foregoing statement is subject to few changes. One or two assistant rangers are generally employed on special tasks of road-making, enumerations, timber extraction and regeneration. An Assistant Conservator has been attached to the District Forest Officer for several years, for the purpose of instruction in office and field duties. At present an Extra Assistant Conservator is also attached for special work entailed in the enumeration and extraction of timber from unreserves. The period for which he will be required is uncertain, and he is not included in the above list.

132. The above establishment is reduced in Part II of this plan by the abolition of Beltangady Range and the transfer of a part of that range to Mangalore Range of North Mangalore Division (vide paragraph 614). This will result in the reduction of the number of range officers in charge of ranges to three only, the reduction of office establishment by one range clerk and one peon, and of protective establishment by one forest guard. Apart from this, however, the existing establishment is the absolute minimum required for effective protection of extensive forests and for the efficient conduct of future works. The protective charge of Uppinangady Range will be enhanced, and works in Kasaragod and Puttur Ranges will be impossible without the help of an assistant ranger in both of these Ranges, which consideration however does not involve any addition to the staff shown above. Some additional protective establishment is proposed for Kasaragod Range (vide paragraph 669).

133. Other proposals may be advanced during the next few years for modification in the distribution of staff to enable the management to cope with timber extraction from unreserves. This does not fall within the scope of this plan and such changes will be of a temporary nature only.

Section 2.—Labour Supply.

134. The recruitment of an adequate labour force during cultivation seasons has been always a difficult problem. The rural population, besides enjoying a higher level of general prosperity than that of most districts, is much scattered and considerably sparser than the population of Malabar. There is little dependence upon the Forest Department for employment. The planting estates in Coorg and Mysore draw the more penurious classes above ghats through the medium of organized recruiting agencies empowered to make advances.

Felling coolies and sawyers are recruited from Malabar and the southern parts of Kasaragod Range. For works in Parappa, Aletti and Jalsur blocks no difficulty has been felt in recruiting skilled or unskilled labour. Sampaje locality, which is now added to Kasaragod Range, is however reported very unhealthy and coastal coolies are reluctant to stay there. In the past three years, a local fund dispensary has been run for the benefit of the local inhabitants of Sampaje, but it was recently closed down as a measure of economy. Coolies for this locality are best recruited from the neighbouring village of Sullia.

The best recruiting centre for unskilled labour required for works in Mujur reserve is the village of Kadaba, five miles from Sunkadakatte. For sawyers, axemen and other imported labour at Baradka (Nalkur reserve), it was necessary to construct a granary

to store commodities during the monsoon month. The employment of jungle tribes, such as the Malekudiyas and Mahrattis has not been tried on any large scale. The former are to be found at Shirady, Charmady, Panja, Subrahmanya, Dharmastala and Neriya but their numbers below ghats are scarce compared with former times. The Mahrattis have no great reputation for work other than their favourite methods of shifting or 'kumri' cultivation, which they are eager to take up wherever permitted to.

CHAPTER V.—PAST SYSTEMS OF MANAGEMENT AND THEIR RESULTS.

I. THE PERIOD OF EARLY FOREST ADMINISTRATION, 1850-1900.

135. *General.*—Forest development in South Kanara has been from inception a slow, difficult and tentative process. The early administrators found a varied and complex district of enormous extent, stretching from the northern limits of Malabar near Tellicherry into the tract known as North Kanara, which however was separated to Bombay Presidency in 1862. They found a heavily afforested country with difficult communications owing to numerous waterways, supporting a scattered agricultural community whose private holdings were distributed often at considerable distances in jungle clearings and who claimed jealously-held but often loosely-defined rights and privileges to the surrounding forest which reached almost to their doors. The executive staff appointed to deal with forest matters was to modern conceptions absurdly inadequate, consisting in a small handful of peons and daffadars borne on the taluk establishments. Protection in any real measure was obviously out of the question. The remoter areas along the ghats and foothills were for long a vast no man's land where kumridars and timber merchants pursued their activities. Kumri cultivation was abolished throughout the major portion of the district in 1860, although not effectively for several years subsequent to this. The forest rules framed by Messrs. Maltby and Hall, and amended by Messrs. Fisher and Robinson, nevertheless did ensure some measure of control over felling activities in the more manageable tracts, and established a regulated system of expenditure calculated to bring in a small annual return to Government.

136. *Mr. Thompson appointed overseer.*—In 1858, Mr. E. Thompson was appointed under the Collector to assist him in forest administration. Mr. Thompson early had to complain of jealousy and obstructionism on the part of local revenue officials. His early tasks were the superintending of the Permit System then in operation, and in the selection of suitable bamboo jungles from which to supply the Mangalore market.

137. *The Licence and Voucher System.*—There can be small doubt that Mr. Thompson's appointment marked the first step in effective control. In 1862, he reported as follows :—"I cut no timber ; I merely mark the trees which are then given over to the merchants who pay seigniorage of 6 annas per Bombay candy on as many candies as they think they can cut and bring to the coast in one year, any timber left over being forfeited to Government and sold in auction." The amount permitted to be cut was stated on the permit issued to the contractor. All timber except nine reserved trees mentioned in the seigniorage list was permitted to be cut. Reserved trees were :—Teak, Rosewood (*Dalbergia latifolia*), Jack (*Artocarpus integrifolia*), Wild Jack (*A. hirsuta*), Poonspar (*Calophyllum tomentosum*) and sandal ; later in 1864, *Hopea parviflora, Hopea Wightiana* and *Albizzia Lebbek* were added. Classified junglewoods permitted for felling were *Terminalia tomentosa, T. paniculata, Xylia xylocarpa, Pterocarpus Marsupium, Albizzia odoratissima* ; the seigniorage on these timbers was raised in 1863 to Re. 1 per candy of 12¾ cubic feet and on unclassified junglewoods to 8 annas per candy, which rates correspond to 1¼ annas and 7½ pies per cubic foot respectively. From the report referred to it appears that the bulk of the timber and bamboos came from Uppinangady taluk, which then comprised also most of what is now Puttur taluk. Mature trees seem to have been scarce, in the Shirady section, since difficulty was mentioned in finding the number of trees in annual demand. The Shirady forests were, however, considered among the best in the district as late as 1870, as were the Subrahmanya forests, which included Nalkur reserve (as it is now known). From the Subrahmanya forests, quantities of rosewood (*Dalbergia latifolia*) and wild jack (*Artocarpus hirsuta*) were extracted for very many years, both on the Permit System and afterwards departmentally. It is unfortunate that records do not now show what was the minimum size of tree considered to be 'mature.' In the year 1860–61, merchants took permits for an aggregate of 2,620 candies (33,400 cubic feet) of junglewood and 220,000 bamboos throughout the district. Timber cost about 5 annas per cubic foot for extraction and transport, and was saleable at Mangalore at about 7–8 annas per cubic foot. Much of this material appears to have found its way to Bombay, but an early administration report remarks on the glutted market on the coast resulting from the large quantities brought down for some years. Departmental working was introduced on a small scale in the more accessible parts about 1865, but was confined to

valuable 'reserved' species, for the reason above given. The Voucher and Licence System continued popular certainly until 1874–75, and Mr. Carroll, Sub-Assistant Conservator in charge of the district in 1883 (a year in which there were no departmental felling operations) described the system then in vogue :—" A party applies for permission for a certain number of logs. On receipt of his application the forester is communicated with as to whether there is any objection to the request being granted. If none, the party is informed as to what instalment he is to pay in advance. . . After payment of the first instalment, permission to fell and square the tree or trees is granted. This done, a measurement list has to be prepared and submitted by the forester, on receipt of which a second permit for the balance due is presented to the party, who after producing the treasury voucher is permitted to remove the produce under a licence." Mr. Carroll noted the following points against the above system in comparison with the stump fee system :—(i) The length of time (seldom under three months) which must elapse before the transaction was completed. (ii) The heavy additional work thrown on the subordinates by being constantly required to send in statements or measurements, etc. " There is every likelihood of their being tempted to submit incorrect measurement lists for the sake of a few rupees or even few annas." In these years, viz., 1882–83 and 1883–84, removal under the Permit System was not large, the figures for the whole district being 4,250 cubic feet in 1882–83 and 3,375 cubic feet in 1883–84.

138. *The Stump Fee System.*—From 1896–1900 the practice was to permit felling of junglewood trees on permit at Rs. 6 per tree for *Terminalia tomentosa* and Rs. 2 for species such as *Eugenia*, Mango, *Schleichera*, etc. This system, introduced for the benefit of the ryot and small purchaser, was reported in 1884 to be working well and to be appreciated by the people.

139. *New species reported.*—*Dipterocarpus indicus*—the first of this genus to be discovered in South India—was identified from these forests in 1863. In the same year *Hopea parviflora* was also remarked on for the first time, and a number of logs were delivered to the Superintendent of the Gun Carriage Manufactory at Bombay. Up to the year 1867, however, there appears to have been but little demand for this species, either locally or from outside, until the Department of Public Works called for 122¾ candies, which were supplied at the rate of Rs. 6–8–0 per candy, or approximately 8 annas per cubic foot.

140. *Forest establishment and organization.*—In 1860, the Forest Overseer's establishment consisted of a daffadar on Rs. 10–8–0 and four peons on Rs. 6. These subordinates were borne on the taluk cutcherry establishment, but on 1st July of that year the posts were transferred as a distinct forest establishment, on the temporary scale, and paid out of forest allotment. Peons were employed in the various forests under felling, and at Uppinangady in checking the rafts coming down the rivers Netravati and Kumaradhari. In 1864, Mr. Thompson was promoted Sub-Assistant Conservator, and had placed under him an overseer (Mr. Goudie) on Rs. 60, with headquarters at Uppinangady. This officer was in charge of the forest posts at Uppinangady, Subrahmanya, Sullia and Malloth. His staff consisted of a daffadar and four peons and he was given two elephants (borrowed from the Commissariat Department, Cannanore) for work near Subrahmanya. In 1884–85, the district of South Kanara was divided for forest administration into two ranges and five sub-ranges, the latter as a rule conterminous with taluk limits. The approximate area of a range was 780 square miles. Each sub-range comprised about four or five guards' beats, including many forests without specified limits and not under special management. Work within these consisted of patrol and check of fellings under the Permit System. The district was subsequently reorganized and the present South Mangalore Division was divided into two ranges, viz., Uppinangady and Kasaragod. Watchers were appointed to look after important reserves, such as Parappa. Additional staff were added thereafter from time to time as became necessary with increase of departmetnal activities, but the territorial organization continued identical until within comparatively recent days.

Departmental operations.

(i) General.

141. Apart from timber, brought by private merchants to Mangalore, strong tendencies on the part of Government to withdraw all restrictions on kumaki produce resulted in the liberation of large quantities of all classes of timber from private lands on to coastal markets. For some years before departmental operations commenced, most of the forests contiguous to convenient lines of export had already been despoiled of their best grade timbers, all such tracts, with the exception of the Sullia Teak forests, having been worked under the Voucher and Licence System. A statement is given showing the values of timber removed and marketed by the department during the period 1862–70. It will be seen that, limited as were the operations, the value of timber lying over annually in the depots or in transit was considerable.

Years. (1)		Expenses incurred. (2)	Nominal value of timber felled. (3)	Value of timber sold. (4)	Value of timber destroyed by fire. (5)	Estimated value of timber unaccounted for at the end of each year. (6)
		RS.	RS.	RS.	RS.	RS.
1862-63	..	1,692	5,281	56	..	5,225
1863-64	..	4,567	15,379	1,725	..	18,879
1864-65	..	7,700	13,366	3,518	1,840	26,887
1865-66	..	8,712	10,857	3,088	556	34,100
1866-67	..	11,843	26,711	12,183	..	48,628
1867-68	..	8,818	9,967	22,792	457	35,346
1868-69	..	11,330	7,444	7,621	426	34,743
1869-70	..	8,323	4,932	7,068	551	32,056
1870-71	..	7,921	5,515	7,819	7,103	22,649
Total	..	**70,906**	**99,452**	**65,870**	**10,933**	**22,649**

The average total rates of preparation, extraction and transport to coastal depots at Mangalore or Kasaragod amounted to about As. 7-6 per cubic foot, and the average rate of sale per cubic foot was about As. 9-1. The profit was accordingly not large. It was explained in 1875 that a large quantity of timber which had to be sold was degraded having been felled prior to 1868 and kept in stock. From 1875 to 1890, timber operations had to be almost entirely suspended in order that the energies of the staff might be available in the endless enquiries into proprietary claims set afoot by the work of Forest Settlement and demarcation. During the period ensuing, even cultural works and works of improvement were practically abandoned. In the year 1891 it was remarked that the progress in works of felling, planting, buildings and roads had fallen notably behind similar progress in other districts of the Southern Circle. Fortunately, it was not a time calling for strenuous efforts in marketing produce. The absence of demand for miscellaneous timber was evidenced by the fact that although a discount of 10 per cent was given in that year (1891) in order to stimulate sales, yet the total number of logs sold amounted only to 357. Grass and minor produce, which was then manipulated by Government agency, was by far the largest item both in receipts and expenditure. From 1892 until the end of the century, some slight recovery in timber trade was effected. Receipts from the sale of timber removed by Government agency averaged Rs. 5,000 to Rs. 6,000 per annum. Transportation of logs from coupe to Panemangalore (a distance varying from 30 to 40 miles) was arranged on contract. Logs were rafted from Panemangalore to Bunder depot. The cost of carting and floating was about 7 annas per cubic foot.

(ii) Forest Settlement, Demarcation and Survey.

142. Up to the year 1874–75, no reserved forests had been formally declared and notified. In this year an enquiry was set afoot in order to settle numerous pressing private claims and to assert Government proprietary rights, since even the Parappa Teak plantations, upon which much money had been spent, were under dispute with private claimants. For three or four years the establishment was completely occupied with this object. In 1885, the total area of 'reserved forest' in the entire district amounted to 1·38 square miles, but in this year Shiradi-Sisla, Dharmastala-Mundaje, Charmady-Kanapady and Bhagimale were notified under section 4 of the Madras Forest Act. The state of affairs in 1890 is given in the accompanying table :—

Forest settlement progress in South Kanara up to the year 1890-91.

	SQ. MLS.
Area of the district excluding zamindaris, etc.	3,883
Cultivated area	632
Uncultivated and forested areas	3,251
Forest under Government Control—	
(*a*) Reserved forest under Act V (1882)	85
(*b*) Reserved lands	940
Total area of forest lands	1,025
Percentage of forest to total area	26·4
Percentage of Government forest lands to uncultivated tracts ..	31·5
Blocks settled and awaiting notification	67
Blocks not under settlement	880

Departmental survey consisted partly in mapping demarcated blocks and in mapping in advance of selection. Two surveyors were employed. The work was carried on well up to the end of last century.

(iii) Works of Improvement and Regeneration.

143. *The Sullia Teak jungles.*—Departmental operations for the tending and improvement of the crops were confined almost exclusively to the tract of country, then much more under forest than now, which lies between Parappa and Sullia (and stretching also beyond to the foot of the ghat at Sampaje), known at that time as "The Sulliah Teak Jungles."

Operations were probably confined chiefly to the northern bank of the river. The tract as far as Sullia was carefully conserved, and at no time permitted to be exploited under the Voucher and Licence System, being the sole exception. The area was said to contain indigenous teak of good quality, young for the most part, but containing individuals of straight growth-habit up to 50 and 60 feet high and 5 feet in circumference. Rosewood (*Dalbergia latifolia*) was interspersed among the crop. It is known from the reports of Thompson (1861) and Beddome (1863) that throughout the great forested tract lying between Adur, Sampaje and Maloth, most of the best timber trees had been felled. This is ascribable to the wide spread devastation wrought by the numerous roving families of kumri cultivators rather than to legitimate (or illegitimate) timber fellings. During the period 1860–70, several lakhs of young teak saplings were pruned and tended, pruning being an operation then much stressed. Unfortunately most of this labour was thrown away, since the property was subsequently established during the time of forest settlement as private warg, and relinquished without acquisition, with the exception of Parappa reserve.

144. *The Parappa Teak Plantations.*—Much of the information here recorded is extracted from Mr. Longrigg's Working Plan for Parappa reserve of 1917, from which quotations are made.

The success of the Nilambur plantations persuaded Dr. Cleghorn to form further plantations near Parappa in 1860, there being some apparent similarity between the two localities. The first site was selected at Kottiadi (Addition I, Compartment 1), on ground which had been recently kumried. In 1862 and 1863 Mr. E. Thompson planted out some 9,000 teak seedlings and 30,000 rosewood in pits during the monsoon. The teak was a failure from the start, operations were discontinued and the place was neglected for 3 or 4 years, during which fire ran through the plantation. Mr. Longrigg remarks :—" If the site of this area has been correctly identified the growth after 54 years does not exceed 40 feet in height ; the girths vary from 14 inches to 2 feet."

145. " In the belief that this failure was due to the location of the plantation on a kumried area, Mr. Thompson, now Assistant Conservator, cleared and planted 14 acres, 3 miles away, on the river bank at Parappa with 14,000 teak, specifically stating that the site was virgin soil. This is the plantation of 1865, and there is no doubt from descriptions of the period that it comprised all that part of the present Plot I to the south of the road (9 acres). Its limits to the north and east are not known as the plantations do not appear to have been mapped prior to 1887. The planting distance was 6′×6′. Some of the plants grew to 6 feet in height in the first year. In 1866 an extension of 25 acres was cleared by Mr. Thompson and planted during the monsoon by Mr. G. Cadell, Assistant Conservator, with 28,000 plants. J. W. Cherry, in a special report on the plantations in 1871, described this as a piece surrounded by undulating ground of dry laterite gravel, which some 15 or 20 years before had been all kumried and was as unsuited for teak plantations as the ground at Kottiadi, which was condemned so strongly. . . In 1869 a second extension of some 20 acres was planted with 24,800 plants ' on lands similar in every respect to that which I have now shown to be a failure, but which at that time must have presented a fair field of young teak ' (Cherry 1871). There is no means of locating this 1869 planting with certainty. . . In April, 1870, H. F. Winter, Assistant Conservator, reported that 30 acres had been planted at a cost of Rs. 3,844–8–9. This works out to Rs. 128 per acre, but it must be remembered that nearly double this area had been planted and later weeded, pruned, etc., before dying out. The same officer gives the height growth at age 5 years as 20 feet, and the average girth of 50 saplings as 7·92 inches. Considering that measurements were probably taken on more or less selected trees this is no better than third class according to Nilambur classification. This indication at such an early age points clearly to the unsuitability of the soil. A great amount of care was lavished on the plantations from the start up to 1874. Weeding was almost constantly in progress. Much pruning was done. . . Buffalo manure was brought, and casualties in 1869–70 were regularly replaced from the nurseries. One or more forest peons were constantly engaged in supervising work in the plantations, and the Overseer at Kasaragod was very frequently there . . . Fire tracing was carried out annually round the Parappa plantations."

146. The further extension of contiguous plantations was therefore discountenanced by Mr. Cherry's unfavourable report. Thereafter it was decided that the operations should be regarded as a '*reboisement*' of the forest. Detached areas in suitable localities were planted with teak, inferior species were cut, existing good trees and saplings were pruned, and the work became more of a general cultural nature. These operations, done in the years 1871–73, included planting out of 37,267 new plants and the replacement of 1,850 casualities. Mr. Longrigg observes that relics of this work appeared to lie between the 24th and 27th milestones on both sides of the Jalsur-Kasaragod road, but that most of it was now excluded from the reserve. In 1874, all work was brought to a standstill on account of disputes which had arisen regarding the ownership of the property ; the greater part

of the plantations were claimed as private wargs. The uncertainty with regard to legal position was not cleared up until verdict was given in the High Court in Bombay in a similar test instance. It was not until 1881 that assurance was given that further hesitation in the spending of money on the plantations need not arise, but in the intervening period casualties owing to neglect were numerous. The plantations were described in that year as "Not very promising. Nearly the whole extent is so overgrown with creepers and the plants themselves so overgrown with suckers that it will take a couple of years weeding to make it look like a plantation again." The total cost up to 1881–82 (exclusive of interest) was Rs. 10,357. Tending operations were carried on until 1884, but the results were described as miserable and Mr. Sturrock reported—"There is no likelihood of our being able to do as good work as is being done at Nilambur." Up to the year 1887, the area was said to be 109 acres, but on remeasurement the correct area was found to be only 52 acres. There were reported to be 17,500 stems of between 1 and 3 feet in girth at breast height, one-third being of the lower dimension with average height of 20 feet, the remainder being from 30 to 35 feet tall. The total cost up to 1888 was Rs. 16,657 including cost of survey.

147. In 1894–95, first attempts were made at introducing *Hopea parviflora* under the teak. This was very successful, and soon overtopped the existing teak. Undergrowth was cleared in 1896.

148. *Record of thinnings.*—The following record is extracted from Mr. Longrigg's Plan.—

(i) 1872–73—This is the first mention of a thinning, no details are known.

(ii) 1882—One thousand dead stems were cut. A trial consignment was sent to Mangalore but the result was unprofitable. Two hundred 'very poor dead poles' were sold on the spot for Rs. 5.

(iii) 1886—One hundred and eighty-three poles were sold for Rs. 26–8–0, i.e., 2 annas 3 pies each.

(iv) 1896—A partial thinning yielded 2,135 poles, at a cost of Rs. 40–8–0. After remaining stacked in the plantation through two monsoons, 1,600 of them were sold for Rs. 90. The rest were unsaleable.

(v) 1899—Seventeen acres out of 52 acres were thinned and 2,700 poles obtained for which there was no demand. Some were used for re-roofing the inspection shed.

(vi) 1900—A further area was thinned, yielding 1,424 poles at a cost of Rs. 8 per 1,000.

(iv) Protection.

149. Inadequate staff and lack of any reliable definition of boundaries rendered impossible any effective protection of Government forests prior to settlement. A special watcher was provided in the case of Parappa. Mr. Cherry reported :—"There can be no doubt that the more valuable species, e.g., teak, Rosewood and Benga (*Pterocarpus Marsupium*), were very largely exterminated in all accessible forest areas, first from want of protective measures, and later on by heavy fellings of all mature trees without any proper system or care for reproduction." The teak plantations (about 115 acres) were fire-traced, and there is no record of serious damage having been caused to them by fire at any time. Dharmastala-Mundaje reserve was the first declared reserve to be fire-traced in 1888.

(v) Sircar Kumri in Kasaragod Range.

150. Previous reference has been made to the enormous damage occasioned all over the district by the practice of kumri cultivation. The prohibition of kumri in Mysore under the British Commission drew many ryots from above ghats, and possibly owing to the existence of the Mercara-Kasaragod road—Mahrattis settled in the neighbourhood of Parappa, Aletti and Adur in large numbers. Although kumri was abolished by Government in 1860 in all Government timber forests, a large part of Kasaragod Range was excepted from the regulations, and kumri was practised at Parappa for 25 years after that date, probably on the plea that it was confined to areas already kumried within 12 years prior to 1860. In 1896 the Department found it necessary to take more active steps than formerly against unlicensed kumri in Government lands. It had been deemed expedient before this to provide some means of subsistence to Mahratti and hill-tribes which owned no private lands and were unused to normal settled modes of agriculture, and a portion of two acres per family per annum had been permitted for kumri, on condition that labour should be forthcoming to the Department when required. A new system was introduced in the following year (1897–98) by which teak and other species were to be introduced with the crops on the payment of Rs. 1–4–0 for every 100 seedlings at the end of the season. The system was readily adopted by the Mahrattis, and to some extent it may have ensured a check on the areas felled over. The tracts given over for this work were pincipally along the lower slopes of Aletti and Adur reserves.

(vi) Introduction of Exotics.

151. (*a*) *Acacia catechu*.—In 1869–70 an attempt was made to form a catechu plantation at Parappa, and 40,000 plants were put out. The experiment was unsuccessful and nearly all died within a few years.

(*b*) *Pinus australis*.—In 1885 seeds of *Pinus australis* were sown in the nursery at Parappa. They did not germinate.

(*c*) *Bambusa gigantea*.—The giant bamboo was introduced in 1881–82 in the compound of the Parappa forest rest-house, and along river-banks in Uppinangady Range. In the next year the clumps at Parappa were said to have attained a height of 6–10 feet with a girth of 2–6 inches, and elsewhere culms 15–20 feet high and 4–7 inches girth were recorded. In 1891 there were over 30 culms in each clump, about 65 feet high and 15 inches in girth. The walls of this bamboo were very thin and useless for floating timber.

(*d*) *Bambusa longispatha*.—This was introduced about the year 1888. Out of 1,145 seeds put out, 1,020 survived in a promising condition. Clumps along the Kumaradhari river were about 50–60 feet high in 1896. By 1905 some clumps were reported to contain each about 260 culms. They were of inferior strength but thornless. Nothing further was reported of them, after 1909.

(*e*) *Swietenia macrophylla*.—This species was planted in the Range office compound at Puttur in 1894–95. The maximum height of three-year old seedlings was 17¾ feet with a girth of 12 inches. The soil was lateritic clay. Although subsequent growth was reported to have been retarded by the attacks of an insect (called the 'Eriya' caterpillar) the minimum height of four-year old seedlings was 22½ feet, the girth being 14 inches. Some of these trees still exist, and their dimensions were reported by the Range Officer, Puttur, in 1929 as follows :—

Serial number.	Girth at breast-height in inches.	Serial number.	Girth at breast-height in inches.
1	70·5	5	64·5
2	60·0	6	69·5
3	59·0	7	74·5
4	48·5		

II. THE PERIOD 1900–20.

152. *Forest settlement*.—Settlement received a check at the commencement of the period owing to difficulties encountered, in the treatment of 'kans' and 'banes' in Sullia and Amara-maganes. About 60,000 acres in Uppinangady Range were notified as reserved forest in 1900–01, practically completing the present list in this range. The reserves included now in Puttur Range were notified under Section 16 chiefly between the years 1903–08, with various additions and extensions up to 1917.

Permanent demarcation was continued more or less '*pari passu*' with survey by the Government of India Survey Party.

153. *Forest survey*.—Survey on a scale of 4 inches to 1 mile was begun in 1901 in Naravi and the northern parts of the division, and was completed for the majority of reserves then settled by 1906. A survey on the scale of two inches to one mile was begun in 1908 and completed for the whole division in 1912.

154. *Railway sleeper operations*.—Railway construction on the West Coast led the department in 1900–01 to contract for the supply of sleepers ; 3,640 logs containing 68,427 cubic feet of *Terminalia tomentosa, Xylia xylocarpa* and *Hopea parviflora*, were felled and converted. The yield was 6,400 sleepers, of which 3,700 were shipped from Mangalore to Badagara. No clear record of the transactions now remains, but Mr. Hart in his working plan refers to these operations at Thodikana and Sampaje, with the remark that they appeared to have resulted in a loss to Government. They were discontinued in the following year.

155. *Kumri operations in Kasaragod Range*.—In Aletti and Adur kumris, 49,500 and 40,600 teak seedlings respectively were raised in 1900–01. One-year old seedlings were planted out. Of these, 34,160 seedlings in Aletti and 30,400 in Adur died in the same or the following year. Survivals, including those of the three previous years numbered 25,585 and 15,210 respectively in the two reserves. The operations were done between the months of July and September. The kumridars were paid at the rate of one rupee per hundred seedlings. It was noted that teak did not do well on the higher ground, but at the foot of slopes two-year old plants reached about 6 feet in height, three-year old plants 8–9 feet in height. No attention could be bestowed on the operations by the Forest establishment, which was occupied in sleeper-cutting work.

In 1903–04, 229 passes were issued to kumridars for an extent of 470 acres, and 14,994 seers of teak, *Terminalia tomentosa* and *Pterocarpus Marsupium* seeds were sown by them. The number of surviving plants from previous years was reported to be 17,819. *Hopea parviflora* was dibbled near streams. A further 380 acres was planted up in 1904–05. In the following year, dibbling of seeds instead of one-year old transplants was tried but the attempt was chiefly a failure, only 614 teak surviving in 1907. Adur reserve was again kumried between 1907 and 1909 ; Mandekole reserve was kumried between 1908 and 1911 ; Medinadka West was kumried between 1912 and 1915. In the years 1907 and 1908, 93 acres were definitely established, and 9,312 seedlings were paid for. In 1910–11, 183 acres were similarly dealt with, but results were poor. In 1915–17, 164 acres were kumried without remuneration, and the operations were thereafter stopped. There is no record anywhere that these plantations were suitably tended, and this in view of the conditions in South Kanara is regrettable, for there could be but one outcome of neglect in the majority of cases. Surviving teak kumries in each of the reserves have been located, surveyed and plotted in 1926–28. Their total area comes to about 200 acres, which is considerable in view of the fact that no attention has been *recorded* prior to 1924–27 or else it has been 'rendered free of cost by subordinates.' The average sum spent in tending these per acre, works out at a little more than twelve annas ! The total area kumried since 1904 could not have been less than 2,000 acres, so that probably 90 per cent of the area covered by these operations is a complete failure. On the richer class of soils, dense semi-evergreen 'kochi' scrub is the resultant type. In some cases *Xylia xylocarpa* is the dominant species. Along the outer borders of reserves, especially in Adur, lantana is in occupation. It is impossible to draw any safe or useful conclusions from the foregoing, for we are quite unable now to envisage what would have been either the quality or the stocking of teak, had reasonable care been provided, nor to what degree the soil itself may have been responsible for failure. These operations were possibly regarded more in the nature of a political expedient than as a serious experiment in forestry, and there can be no doubt that their extent was considerably in excess of that which the establishment could adequately have dealt with, and they found no place in the Working Plan prescriptions of the period.

These teak kumries, however, being of known age, might have provided growth-data worthy of record. Mr. Longrigg when District Forest Officer ordered that all the various kumried areas be plotted on Survey of India sheets for future reference but if this was done, the sheets have been lost subsequently and the age of non-teak kumried areas is not now certain.

156. A table showing existing teak kumries with their known history is shown below :—

Teak kumries in Kasaragod Range.

Number. (1)	Name of plantation. (2)	Name of Reserved forest. (3)	Area in acres. (4)	Date of formation. (5)	Date of tending. (6)	Cost of tending. (7) RS. A. P.
1	Paimbachal	Aletti, West ..	3·50			
2	Nanguli I and II ..	Do. ..	3·98			
3	Kalangathamale ..	Do. ..	10·30			
4	Devakaje	Do. ..	6·80			
5	Kannadichallu ..	Do. ..	30·40			
6	Pallamoola	Do. ..	19·80	From 1904 to 1909	1926	89 3 0
7	Haspara	Do. ..	5·40			
8	Adapangaya, I and II.	Do. ..	6·10			
9	Sheik Patti, I and II.	Aletti, East ..	4·90			
10	Chernur	Do. ..	2.50			
11	Bettangaya	Do. ..	2·60			
12	Chandakanna ..	Medinadka, West.	4·30	1915		
13	Haspara	Do.	11·58	1912		
14	Theppa Kana ..	Do.	3·20	1912		
15	Kudambi	Do.	1·00	1913	1924 and 1926	50 5 0
16	Anakallu, I and II ..	Do.	3·35	1914		
17	Yenuvara	Do.	20·00	1914		
18	Barkaje	Do.	4·20	1913		
19	Ballakana	Adur	5·40	1909		
20	Ettinadi (Chinnadi) ..	Do.	2·00	1900		
21	Mandabetta	Do.	..	1909		
22	Katapara	Do.	5·00	1907	1927	13 2 0
23	Palikochu	Do.	1·85	1913		
24	Balanthadka	Do.	0·88	1904		
25	Ballaegaya	Do.	1·35	1907		
26	Ballarkaje	Do.	2·12	1909		
27	Kallarimala	Mandekole ..	8·50	1908		
28	Papathadka	Do. ..	1·20	1908		
29	Chirukudal	Do. ..	16·70	1910	1926	*Nil.* Free by V.T.S.
30	Maruthimalai ..	Do. ..	3·30	1910		
31	Chakote	Do. ..	2·40	1911		
32	Anegundi	Do. ..	2·40	1909		

PAST WORKING PLANS.

A.—*Mr. Foulkes' Working Plan.*

157. *Aim and scope.*—Mr. Foulkes' Working Plan (sanctioned in Board's Proceedings Forest No. 255 of 6th September 1902) covered the Puttur, Kasaragod and Uppinangady Ranges and was intended to regularize working of timber and fuel. Its objects were to define the annual timber extraction by area and volume; to arrange a sustained supply of fuel to then important centres; and to provide for adequate rest and protection to those tracts which had suffered severely from excessive kumri and other fellings in former years. All reserves notified were formed into seven working circles, as follows :—

I Shiradi Timber Working Circle comprised Porkala, Shibaje and Kadambilla reserves; total area 9,671 acres.

II The Shiradi Fuel Working Circle, comprised Nerankimale, and parts of Porkala, Kadambilla, Shibaje, Konaje and Kombar reserves; total area 13,664 acres.

III Nerankimale Bamboo Working Circle; area 3,892 acres.

IV Uppinangady Range Closed Working Circle comprised Dharmastala Mundaje, Charmady, Kanapadi, Bhagimale, Naravi, Nidle, Mujur, Padnur, Kidu and Miyar reserves; total area 93,330 acres.

V Puttur Town Fuel Working Circle comprising Narimogar reserve; area 1,588 acres.

VI Coast Railway Fuel Working Circle comprising Muliyar and Karadka reserves; total area 1,977 acres.

VII Puttur Range Closed Working Circle comprising Parappa, Kanakamajulu, Kalanjimale and Virakamba reserves; total area 9,541 acres.

158. *The Shiradi Timber Working Circle.*—During the years 1895–1900 the average number of trees felled was about 200 and logs sold at Mangalore, numbered about 270. The 'possibility' was accordingly fixed at 200 trees per annum for the ensuing ten years, from 1902–03 to 1912–13, with discretion left to the management to reduce the fellings if market conditions were unable to absorb this quantity. Increase above that number could only be sanctioned by the Conservator. The method of fellings was by a modified form of Selection System, the annual cut being arbitrarily defined by area and volume. A minimum girth of five feet was insisted upon, but *Xylia* of two feet girth was allowed by a supplementary clause. *Dalbergia latifolia* and *Pterocarpus Marsupium* were prohibited from being felled, and the number of *Terminalia tomentosa* trees permitted was limited to 50 per year. Dead trees still sound were marked for extraction. Reproduction was left to coppice-shoots from felled stumps, and to natural-sown seedlings; provision was made for suitable seed-bearers to be left in each coupe. Provision was also made for dibbling *Hopea parviflora* seeds in 10 acres of the Parappa plantations each year. Fire-protection was rendered more efficient in all reserves, especially those under working. Supplementary regulations affecting creeper-cutting and sale of bamboos were also added.

159. The working of the circle is shown in the following statement :

Shiradi Timber Working Circle—Yield and Working (1903–22).

(Sanctioned in Board's Proceedings Forest No. 255, dated 6th September 1902.)

I. Working plan prescriptions.

Year.	Coupe number.	Reserve.	Area of coupe. acres.
	1st *Rotation* :—		
1903–04	I	Porkala	1,000
1904–05	II	Do.	1,000
1905–06	III	Do.	1,050
1906 07	IV	Do.	1,000
1907–08	V	Porkala Shibaje	488 512
1908–09	VI	Shibaje	1,000
1909–10	VII	Do.	944
1910–11	VIII	Do.	1,000
1911–12	IX	Do.	850
1912–13	X	Kadimbilla	827
	Second rotation.		
	Nil.		

II. Order of actual working.

Year.	Reserve.	Coupe number.	Area worked acres.	Outturn. LOGS.	Outturn. C.FT.	Revenue. RS. A. P.	Expenditure. RS. A. P.	Method of disposal.
1903–04	Porkala	I	1,000	115	6,181	Not known.	Not known	Carted to Vollal and floated to Bunder, Mangalore.
1904–05	Nil.		Nil.					
1905–06	Porkala	II	1,000	215	9,559	Not known	Not known	
1906–07	Do.	III IV	1,050 1,000	174 245	8,280 11,711	Do. Do.	Do. Do.	
1907–08	Do.	V	488	100	6,029	Do.	Do.	
1908–09	Shibaje	V	512	79	3,756	Do.	Do.	
1909–10	Nil		Nil.					
1910–11	Shibaje	VI	1,000	164	3,634	Not known	Not known	
1911 to 1914	Do.	VII	944	391	8,803·5	Do.	Do.	
1914–15	Nil.		Nil.					
1915–16	Shibaje	VIII	1,000	200	5,000	1,572 0 0	72 0 0	Sold at stump for lump sum.
1916–17	Kadimbilla	IX	850	273	13,145	4,369 15 0	513 15 9	Sold at road-side and Bunder, Mangalore.
1917–18	Do.	X	827	200	10,794	3,366 0 0	213 14 3	Sold at road-side.
1918–19	Porkala	I	734·7	307	8,547	Not Known	Not known	Carted to Vollal and rafted to Mangalore.
1919–20	Do.	II	497	210	4,663	..	..	
1920–21	Do.	II	..	31	661	..	..	
1921–22	Do.	II	..	152	4,384	3,288 0 0	1,320 7 9	
1922–23	Padnur	I	83·4	344	7,261	Not known	Not known	Sawing in coupe. Logs and sawn material transhipped to Mangalore.
1923–24	Do.	II	157·4	529	9,499·7	Do.	Do.	

Statement showing outturn from the Shiradi Timber Working Circle.

Serial number.	Name of reserve and coupe.	Terminalia paniculata.		Terminalia tomentosa.		Dalbergia latifolia.		Lagerstrœmia lanceolata.		Pterocarpus marsupium.		Adina cordifolia.		Albizzia species.		Xylia xylocarpa.		Stephegyne parvifolia.		Bridelia retusa.		Artocarpus integrifolia.		Artocarpus hirsuta.		Miscellaneous species.		Total outturn.	
		NO.	C.FT.	NO.	C.FT.	NO.	C.FT.	NO.	C.FT.	NO.	C.FT.	NO.	C.FT.	NO.	C.FT.	NO.	C.FT.	NO.	C.FT.	NO.	C.FT.	NO.	C.FT.	NO.	C.FT.	NO.	C.FT.	NO.	C.FT.
1	Porkala I	209	7,447	125	3,311	10	156	48	4,540	9	231	30	833	35	1,043	46	1,039	1	37	9	135	..	..	..	..	18	1,392	540	20,164
2	Do. II	183	7,508	65	2,576	3	69	52	1,622	9	221	4	260	2	90	6	30	..	..	1	40	..	..	..	..	12	684	337	13,150
3	Do. III	101	4,891	25	1,268	1	60	19	870	7	55	..	..	..	..	1	47	..	..	1	23	..	..	..	..	23	1,066	172	8,280
4	Do. IV	100	5,318	40	1,682	4	112	41	1,718	3	120	3	406	3	149	14	133	..	..	..	..	..	..	..	..	37	2,081	245	11,719
5	Do. V (Part)	35	1,918	26	1,597	..	..	12	627	..	..	3	253	1	77	2	90	..	..	..	..	1	53	2	663	13	1,000	95	6,278
6	Shibaje V (Part)	42	1,911	14	735	..	..	..	..	10	331	3	315	..	..	3	61	..	..	..	..	..	..	..	..	5	402	77	3,755
7	Do. VI (Part)	13	341	32	648	2	75	6	202	..	..	19	667	..	..	92	1,760	..	..	..	..	..	..	..	..	..	..	164	3,683
8	Do. VII	21	638	123	2,530	2	45	33	990	..	..	3	161	..	..	209	4,438	..	..	..	..	..	..	..	..	..	..	391	8,802
9	Do. VIII	10	279	187	4,995	..	..	31	843	1	24	..	..	..	..	17	440	..	..	..	..	..	..	6	250	..	..	252	6,831
10	Kadimbilla IX	54	2,906	86	3,877	5	183	41	2,175	..	..	12	1,027	4	87	72	2,615	..	..	..	..	..	..	6	434	..	..	280	13,304
11	Do. X	30	2,010	23	1,480	1	37	8	697	..	..	2	289	3	308	17	4,675	..	..	..	..	..	..	6	1,283	..	..	90	10,779

The Fuel Working Circles.

160. (*a*) *The Shiradi Fuel Working Circle.*—The circle was conceived with the intention of controlling the supply of fuel to the then conjectured Mangalore-Arsikere Railway extension, which was anticipated to run close to these reserves, via, the Shiradi ghat. The average size of the annual coupes was slightly more than 500 acres, it being provided however, that no timber species were to be cut. This cumbersome scheme was fortunately never called into operation, as the railway is not yet built.

161. (*b*) *The Puttur Town Fuel Working Circle.*—Narimogar reserve was selected to be worked on a rotation of 24 years, each coupe covering approximately 47 acres. The system was by " Coppice with Standards ". Owing to the demand from Puttur falling short of that anticipated, the scheme did not work very successfully. Some fuel was carted to Kasaragod, but difficulties in transport and high cost led to the abandonment of some of the coupes in 1908–09. The working of this circle was stopped in 1917.

162. (*c*) *The Coastal Fuel Working Circle.*—This was also intended to supply fuel to the West Coast Railway, but the expected market entirely failed. A fresh market was however providentially discovered in the newly built Kasaragod tile-factory. Muliar reserve was regulated to be worked on a 25-year rotation, the average size of the coupes being 80 acres. This circle was modified in 1915, and a new plan formulated.

A summary of the operations carried out in Narimogar and Muliar reserves under this working plan is provided in the consolidated table of past fuel workings in paragraphs 167 and 256.

163. *The Bamboo Working Circle.*—Nerankimale reserve was the sole area constituting this circle. The first rotation from 1902–03 to 1909–10 covered the area in seven annual coupes of 556 acres each. Some of these coupes were worked on contract, and the majority departmentally. In the latter case the bamboos were sold cut and stacked on the ground. The following table drawn from Mr. Longrigg's proposed working plan for this reserve formulated about 1919, gives a record of working :—

Neerankimalai Bamboo Working Circle.

Number of Coupe.	Year of working.	Agency of working.	Cost of working.	Outturn of bamboos.	Total outturn of coupe.	Revenue.	Remarks.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			RS. A. P.		C.FT.	RS. A. P.	
Coupe VII ..	1903–04	Departmental ..	60 0 0	800	800	..	Sold at Bunder. Rafted to Mangalore at Rs. 2–8–0 per 100.
Coupe VI ..	1904–05	Departmental ..	30 0 0	1,000	1,000	..	Column (4) felling charges only.
Coupe I ..	1906–07 } 1907–08 }	Permit System ..	..	1,100	..	16 8 0	
	1914–15	Contract	..	7,400	8,500	550 0 0	
Coupe III ..	1907–08	Departmental ..	..	931	..	..	For rafting logs.
	1908–09	Do. ..	775 7 9	11,450	..	..	465 sold in coupe at Rs. 5 per 100.
	1908–09	Permit System ..	..	300	..	4 8 0	
	1910–11	Departmental ..	46 5 2	1,000	..	..	500 floated to Mangalore.
	1911–12	Do. ..		4,600	..	..	10,000 sold at riverside at Rs. 9 per 100.
	1912–13	Permit System ..		500	..	28 12 0	
	1913–14	Departmental	6 4	15,073	..	..	
	1917–18	Do.	..	1,700	..	..	745 sold at riverside.
	1917–18	Contract	..	14,450	50,004	440 0 0	
Coupe IV ..	1909–10	Departmental ..	605 4 [illegible]	12,950	..	..	
	1911–12	Do. ..	..	1,700	..	..	5,100 floated to Mangalore.
	1912–13	Do. ..	..	21,502	36,152	..	
Coupe V ..	1911–12	Departmental ..	..	16,075	16,075	..	To Vollal for floating logs.
Coupe II ..	1915–16	Contract	..	40,430	40,430	600 0 0	

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164. It is noticed that coupe III, which was the easiest of access, yielded 50,000 bamboos, which was one-third of the total outturn for the whole 15 years ; while coupes VI and VII, the most remote from the river, appear hardly to have been worked at all. The principal object of the fellings as far as the department was concerned was to supply bamboos at Vollal for rafting to Mangalore. Logs cut in the Shiradi Timber Working Circle all came out via Uppinangady. Between 1914 and 1918, the transport of logs via this route ceased, and coupes were sold standing to contractors as follows :—

1914–15,	Coupe	I	for Rs.	550 to V. P. Mallaya of Mangalore.
1915–16	,,	II	,,	600 to Hammad Sahib.
1916–17	,,	III	,,	500 to B. D'Sa.
1917–18	,,	III	,,	440 to another contractor as D'Sa failed to work.

The following extracts from District Forest Officers' diaries contain various points of interest bearing on the management of the bamboo coupes :—

Mr. B. H. Barlow Poole (4th April 1908) :—" Little bamboo cutting has been done but this is due to the fact that there has been a hitch about floating timber. All floating operations have come to a full stop."

Mr. D. T. Barry (14th November 1908) :—" Inspected bamboo coupe III. We have now felled as many bamboos as we can sell and for that matter as many as we can float this year . . . The fellings have been satisfactorily carried out. The supply in the forest much exceeds the demand. If the demand could be increased fellings would be remunerative as well as advisable from a sylvicultural point of view."

Mr. D. T. Barry (17th January 1911) :—" Inspected bamboo coupes. The attempt to cut the bamboos departmentally within two feet from the ground has been a failure this year for want of sufficient staff to supervise the work. The main faults were cutting too many culms in a clump with the result that the remainder have insufficient support in the monsoon, and cutting too many young culms. I came to the conclusion that the ordinary cheap and slack method of cutting the thorny bamboo (*B. Arundinacea*) 12 feet from the ground has much to recommend it. It is cheap and financially practicable (cutting the lower portion is expensive on account of the thorns and when cut it is unsaleable, difficult to extract and of little use for rafting purposes). It requires less intelligent supervision. The danger of overfelling and weakening the new shoots is reduced, as 12 feet of culm remains, which affords a useful support to the new culms. As regards the straightness of the bamboos grown under either method it is doubtful if there would be much to choose as we are only concerned with the top pieces."

Mr. D. T. Barry (14th July 1912) :—" For some unknown reason we have never attempted to make a road for the extraction of the bamboos through this reserve to the Netravati river. It seems to me clear that fire protection is improving in Nerankimale and so far has benefited the forest, not forgetting the bamboos. When it becomes densely evergreen the bamboos will gradually diminish in numbers." (This would now appear in fact to have happened, but it is difficult to gauge accurately without having been conversant with the former appearance of the forest prior to bamboo seeding ; moreover seedling regeneration is inconspicuous for a number of years. What appears to have happened over the majority of the reserve is that bamboo regeneration is succeeding noticeably only in a few fair sized groups. This has been all the more so in recent fuel coupes, where complete removal of cover, unaccompanied by burning, has stimulated a dense herbaceous ground flora, greatly to the disadvantage of bamboo regeneration).

Mr. R. D. Richmond (24th January 1915) :—" The forest is largely overrun with bamboos which have been felled in a desultory manner from time to time. The fact that they have been cut ten feet from the ground does not appear to have interfered with the growth of the bamboos in the clump."

An experiment in this connection was done by the Forest Guards Vernacular Training School at Parappa in 1914. Nine bamboo clumps were felled, leaving 7 to 10 young culms in each clump uncut. The bamboos were cut at two feet above the ground. The ranger in charge (Mr. Kunhirayan) wrote :—" Purchasers do not take the bottom portion as they say they are too heavy to be floated." Eight [illegible]dred and eleven bamboos were dressed, i.e., 510 bottom pieces, and 301 top pieces. [illegible]ing the students as coolies at four annas each the expenditure on the work would [illegible]een Rs. 30–4–0 or Rs. 3–12–0 per 100 bamboos.

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165. *Summary of results.*—Probably the most noteworthy and beneficial provision of Mr. Foulkes' Plan was the selection and isolation of those blocks most in need of protection, with a resulting timely period of freedom from disturbance. These reserves, notably Kombar, Dharmastala Mundaje, Kidu and Nidle Blocks have made undoubtedly vast improvement in the degree of stocking. Grassy blanks in Kombar reserve are now covered with trees of typical deciduous type up to 40 feet in height. The undergrowth in the majority of cases is now becoming evergreen, which, however, it might inhibit further deciduous regeneration is an undoubted indicator of soil improvement, and humus accumulation. With the exception of Mujur reserve, the majority of these forests remain still too immature for successful timber working.

The coupes prescribed for timber working in the Shiradi Timber Working Circle were cumbersome for convenient working, and although the prescriptions were fairly closely followed for many years, it seems doubtful whether the entire areas were uniformly felled in all cases. The intensity of felling should have been extremely light, but there are considerable blanks still noticeable in the later coupes of Shibaje and Kadambilla blocks. The possibility of the Mangalore market was not unduly underestimated. In

1908, the District Forest Officer (Mr. Barry) wrote that in the forest and other depots of Uppinangady Range there remained a balance of stock of 26,150 cubic feet, while in Mangalore there were 403 logs of 7,950 cubic feet. During 1907–08 only 222 logs of 4,999 cubic feet were sold, and the sale in any one year never exceeded 300 logs. Accordingly only 391 logs of 8,800 cubic feet were felled in coupe VII of Shibaje during the years 1911–14. The last coupe of the series (coupe X of Kadambilla Block) which according to prescription should have been felled in 1912–13 was not felled until 1917–18. A second series was commenced in the year 1918–19 in coupe I of Porkala reserve, with an out-turn of 8,547 cubic feet. Possibly owing to post-war depression, but also due to fellings in Jalsur East under Mr. Hart's scheme, the quantity extracted up to 1922 was even less than the above. Subsequent to 1923 the intention and scope of the fellings became so widely divergent from that contemplated in the original plan that it was cancelled.

In the manner of replacement of fellings, the plan was hardly adequate. Coppice regeneration from stools of six feet girth and upwards is dubious, and seedling growth in gaps cannot be relied upon without subsequent tending. Nevertheless fire-protection measures have undoubtedly increased the proportion of younger age-classes throughout the forest. The prescription to undersow *Hopea parviflora* in the Parappa plantations was not carried out, for reasons unknown, but some broadcast sowing of this species was done by Mr. Barry in 1913, in Compartment 7 of Parappa.

Creeper cutting under the supplementary provisions of the Plan was adequately carried out and should have been of value.

B.—Mr. Hart's Working Scheme for the extraction of over-mature timber from reserves tapped by the Paiswani river and tributaries.

166. This plan, sanctioned in Board's Proceedings (Forest) Mis. No. 511, dated 2nd August 1915, dealt with the following reserves, viz., Parappa, Mandekole, Jalsur East, Thodikan, Sampaje, Medinadka East and West, Jalsur West and Aletti West. Most of these reserves were notified at a later date than Mr. Foulkes' Plan of 1902, which was already out of date for practical purposes by 1915. Mr. Hart stated that the condition of these forests was such that a regular working plan for them was impracticable on account of their irregular nature. Jalsur East, Sampaje, Aletti East and Parappa however, contained stands of considerable value. Mr. Hart carried out strip enumerations, and prepared some rough stockmaps. The plan was executed under very disadvantageous conditions, and suffered accordingly in accuracy. The only reserve to which it was applied was Jalsur East, which contained a splendid crop of mature and over-mature mixed evergreen and semi-evergreen jungle. No supplementary regulations regarding the tending and regeneration of the crop were made in this plan, which appears to have been in accordance with the orders of the Conservator to the District Forest Officer, that "No scientific precautions, not even with respect of seed regeneration for these trees is called for." An addendum to this plan was submitted for sanction in April 1917, prescribing measures necessary to secure regeneration of *Hopea parviflora* and other species in coupe I and subsequent coupes of Jalsur East reserve (vide Board's Proceedings Mis. No. 218, dated 19th July 1917). By this, light improvement fellings were to be conducted in the evergreen understorey in order to stimulate but protect natural Hopea regeneration, and climber-cutting was prescribed annually.

Felling prescriptions were on the basis of selection fellings of species for which there was a reasonable demand, with the object of removing all over-mature stems in the areas defined by Mr. Hart during the course of the ten-year period 1915–25. The minimum exploitable girth-limits were five feet six inches for *Xylia xylocarpa*; six feet for *Artocarpus integrifolia, Lagerstrœmia lanceolata, Mesua ferrea,* and *Vitex altissima*; and seven feet for all other species. Trees necessary as seed-bearers or for protection of grassy blanks were retained, but dead and dying trees were to be marked for removal. The scheme provided for the extraction of a total quantity of 24 lakhs of cubic feet of timber during the 10-year period over a total area of about 3,420 acres. The estimate was much too optimistic, being based on very inadequate enumeration data, and could not have been put into practice. The quantity actually extracted up to March 1923 was 95,000 cubic feet only, from the single reserve of Jalsur East. The plan was cancelled by order of the Chief Conservator in 1923.

C.—The Working Plan for Muliar Reserve.

167. This reserve had been under a plan of working since 1902 (Mr. Foulkes' Plan—Coast Railway Fuel Working Circle). The prescriptions of the old plan were found by 1912 to be a complete failure; by the year 1913–14, 948 acres of the reserve should have been felled, whereas in fact only 168 acres had been covered. This was due, it was

stated, to bad location of coupes, and absence of demand from the railway, which utilized coal instead of billet fuel. Accordingly, a revised plan was prepared by M.R.Ry. V. Raman Menon and sanctioned in Board's Proceedings Forest Mis. No. 663, dated 22nd October 1915. The reserve continued to be applied for the production of fuel, but coupes were rearranged and considerably reduced. A rotation of 30 years replaced the former period of 25 years, coupes being arranged to meet an anticipated demand for 250 'chowks' per annum (one 'chowk' is equivalent to 216 cubic feet of fuelwood billetted and stacked, or three tons approximately). Priority of extraction was allotted to coupes nearest the banks of the navigable Paiswani river. Lantana eradication was prescribed for three years, beginning in the year prior to felling of the coupe followed by removal of seedlings which came up during the two subsequent years. The system of felling prescribed was 'Coppice with Standards.' The system of 'Simple Coppice' was substituted in 1924–25. A prescription to sow *Hopea parviflora* seeds broadcast in each coupe after felling was cancelled in 1924. The plan has remained in force up to date but now requires revision, since the coupes constituting the northern parts of the reserve which are due for felling in the current rotation are unfit for working. The prescription for lantana eradication has not been successful in eliminating lantana, from the felled coupes. It is often dense, but probably no more pernicious than *Caesalpinea mimusoides* and other thorny climbers. In the older coupes, lantana is by no means excessive, and exists chiefly round the edges of the coupe, having been largely suppressed in the interior. A statement of actual yields and working during the years 1908-30 is given below :—

Muliar Reserve—Yield and Working.

Year of working.	Coupe number.	Area of coupe.	Area worked.	Outturn. Fuel.	Outturn. Timber.	Outturn. Bamboo.	System of working.	Revenue. Total.	Revenue. Net per acre.	Expenditure.	How disposed.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
		ACS.	ACS.	CHOWKS.	C.FT			RS. A. P.	RS. A. P.	RS. A. P.	
(Old series.) 1908–09 to 1912–13.	I	75	..	750·7	428·2	2,225	Coppice with Standards.	10,509 10 6	..	8,562 2 1	At Bhavikere coupe-side.
1912–13 ..	II	93	25	166	..	3,000	Do.	5,235 8 0	29 12 1	3,360 14 4	Do.
1913–14 ..	II	93	38	206	430·9	2,550					
(New series). 1914–15 ..	I	48	15·75	130	2366	..	Do.	4,703 13 0	61 12 0	1,739 1 6	Fuel at coupe-side; timber auctioned.
1915–16 ..	I	48	22·25	276							
1915–16 ..	II	64·6	64·6	450	650	2,000	Do.	1,093 4 0	16 9 0	21 5 10	Contract: Rs. 15 per acre.
1916–17 ..	III	60·8	60·8	213	2,268	1,730	Do.	1,069 4 0	16 7 5	68 2 0	Contract: Rs. 14 per acre.
1917–18 ..	IV	52	30·25	157	34	Nil.	Do.	974 6 0	18 7 5	14 11 6	Contract: Rs. 20 per acre.
1918–19 ..	IV	52	11·25	12	1,643	Nil.					
1918–19 ..	V	58·4	58·4	180	1,949	Nil.	Do.	1,314 0 0	22 5 0	11 10 11	Contract: Rs. 22–8 per acre.
1919–20 ..	VI	61·9	23	50	Not Known.	Nil.	Do.	1,052 4 9	16 8 0	31 9 0	Contract: Rs. 17 per acre.
1920–21 ..	VI	61·9	38·9	186	732						
1920–21 ..	VII	55·97	..	..	Not known.	Nil.	Do.	895 8 4	..	11 0 0	Contract: Rs. 16 per acre.
1921–22 ..	VIII	62·05	30	95	1,700	Nil.	Do.	868 11 2	13 9 0	28 3 6	Contract: Rs. 14 per acre.
1922–23 ..	VIII	62·05	..	211							
1923–24 ..	IX	57·5	47	216	1,111	Nil.	Do.	690 0 0	11 7 0	33 8 5	Contract: Rs. 12 per acre.
1924–25 ..	IX	57·5	10								
1924–25 ..	X	78·4	78·4	423	1,958	Nil.	Simple coppice.	2,077 10 0	26 8 0	..	Contract; Rs. 26–8 per acre.
1925–26 ..	XI	65·7	65·7	221	521·5	Nil.	Do.	1,149 12 0	17 8 0	..	Contract: Rs. 17–8 per acre.
1926–27 ..	XIV	54·6	54·6	144	1,074	Nil.	Do.	546 0 0	9 11 0	18 0 0	Contract: Rs. 10 per acre.
1927–28 ..	XV	80	80	201	741	Nil.	Do.	720 0 0	9 0 0	..	Contract: Rs. 9 per acre.
1928–29 ..	XVI	53	53	148	962	Nil.	Do.	506 13 0	9 7 0	7 8 0	Contract: Rs. 9–9 per acre.
1929–30 ..	XVII	72	53	288	2,903	Nil.	Do.	864 0 0	11 12 0	16 14 0	Contract: Rs. 12 per acre.

One chowk equals 216 cubic feet of stacked billets or 3 tons.

NOTE.—Old series—Under working plan sanctioned in Board's Proceedings (Forest), No. 255, dated 6th September 1902 (*Coast Railway Fuel* Working Circle).

New Series—Under revised working plan sanctioned in Board's Proceedings (Forest) Mis. No. 663, dated 22nd October 1915.

D.—Mr. Longrigg's Working Plan for Parappa Reserve.

168. *Scope and object.*—This plan, sanctioned in Board's Proceedings Forest No. 156, dated 26th April 1918, provided for the management of the reserve for a period of ten years commencing from March 1916. The reserve was divided into ten permanently demarcated compartments, which have been retained in this working plan.

The prescriptions fell under three heads :—

(i) Improvement fellings, intended to improve the growing stock over the whole area ;

(ii) Cultural operations, chiefly the extension of Hopea sowings in suitable strips and patches ;

(iii) Miscellaneous prescriptions.

The improvement felling prescriptions provided for the systematic removal of trees of saleable species above three feet in girth, which were badly shaped, unsound, dead or dying, or were interfering with the growth of individuals better than themselves. The proviso was made that no marking should unduly expose the soil, and openings made

in the canopy should be such that they would readily close again. *Dalbergia latifolia* and *Pterocarpus Marsupium* were to be sparingly marked, with the object of restoring their former proportion in the crop. Girdling of inferior species and the eradication of lantana by uprootal were also prescribed.

The cultural operations consisted in sowing Hopea under the teak plantations, and in the broadcast sowing of Hopea in 10 acres annually. The limits of the regeneration area were not defined, but it was provided that each plot should be semi-permanently demarcated.

The plan also provided that statistical data both for teak and Hopea should be collected, and that factors believed adversely affecting the growth of Hopea in youth should be observed and recorded.

169. *Operation.*—Systematic working began in 1916–17 and continued until 1919–20. About 50,000 cubic feet of timber was extracted from 1,000 acres, in compartments 1, 2, 3, 4 and part of 5. Timber felled in compartments 3 and 4 was sold to contractors at the coupe site. The procedure led to deviation from the plan, since the contractor for compartment 4 failed to remove more than a small proportion of timber lying in the compartment, and only a portion of compartment 5 was worked over in 1920. In the year 1920–21, however the whole scope and object of the fellings was so materially altered by order of Mr. Tireman, then Chief Conservator of Forests, that the plan became inoperative and was cancelled.

170. *Control records.*—Control records were very inadequately maintained up to the year 1915, and in many cases information of specific nature, viz., locality and extent of climber-cutting and improvement fellings, and even of expenditure and revenue from major fellings is impossible now to obtain or confirm.

Much of this is due to the fact that from 1912 onwards the 1902 working plan became obsolete. It was however officially maintained in force until 1923. The matter was further complicated by the fact that the plan covered almost every reserve in the division, and in the later stages deviation statements were so cumbersome that the plan was virtually ignored. Without previously obtaining cancellation of the original plan, new working plans were formulated and sanctioned for specific areas and individual reserves. These again, with the exception of Mr. Raman Menon's plan for Muliar fuel reserve, were unworkable, or policies changed in the meanwhile. Control records prescribed in the early stages of the 1902 plan were so lax as to be almost negligible ; subsequently they were to large extent ignored. Many records concerning the working of Shiradi Working Circle in Uppinangady Range which might have been useful were destroyed in the floods of 1923.

Hopea Improvement Operations.

171. Sundry works for the improvement and encouragement of existing Hopea natural regeneration were undertaken during years 1909 and 1918. These were embodied in a definite scheme sanctioned in Board's Proceedings Forest No. 249, dated 9th October 1911, but detailed records of the operations do not seem to have been separately maintained. Information such as there is is recorded in the District Forest Officer's Note book. The principal works were conducted in Kidu and Yenekal reserves.

172. (i) *Kidu reserve.*—For purposes of control the reserve was divided into nine coupes, of which eight are contiguous in the main block alongside the river, the last being north of the Bisale Ghat road. The following are details of the work done :—

Coupe number.	Years when worked.		Area tended.	Description of work.	Amount spent.		
			ACRES.		RS.	A.	P.
I	(a)	1909–10	179	Girdling, removing undergrowth, opening canopy.	45	0	0
	(b)	1913–14	193	Do.	50	0	0
I and II (c) ..		1913–14	40	Creeper cutting, removing undergrowth, girdling softwoods.	20	0	0
II (a)		1910–11	19	Do. do.	4	12	0
(b)		1914–15	101	Do. do.	32	0	0
III (a)		1912–13	212	Do. do.	70	8	0
(b)		1915–16	..	Regirdling, climber-cutting	9	12	0
(c)		1916–17	..	Cutting small creepers, opening canopy, removing Strobilanthes.	30	0	0
IV (a)		1912–13	..	Do. do.	(Included in Coupe III.)		
(b)		1916–17	..	Do. do.	Do.		
V		1913–14	..	Do. do.	Not Known.		
VI		1914–15	193	Do. do.	60	0	0
VII (a)		1915–16	..	Do. do.	30	4	0
					Not known.		
VIII (a)		1915–16	..	Do. do.	Do.		
(b)		1916–17	203	Do. do.	56	0	0
IX ..		..	No record.	..	(Included with coupe VII.)		

Lines eight feet to ten feet broad are still annually cleared, fire-traced and maintained between the original coupes. It would be advisable to retain them as compartment boundaries. The total sum spent up to March 1917 was Rs. 494–13–0. The areas tended shown in column 3 of the above statement are not necessarily the areas of the ' coupes '. The entire area is now to be taken up again under the ' Hopea Improvement Working Circle.' It has been remapped, and the Hopea areas shown.

173. (ii) *Yenekal reserve.*—This reserve was similarly treated over three patches of area approximately 275 acres in total extent. These patches were demarcated by six feet lines, and name-boards were erected. (Unfortunately, both lines and boards are now obliterated.) A map of these natural Hopea patches exists in the District Office, but a separate map has been made in connection with the prescription under ' Hopea Improvement Working Circle ' in this plan. The operations completed during the years 1910–1918 are shown as follows :—

Year.	Description of work.	Amount spent.		
		RS.	A.	P.
1909–10	Creeper-cutting, breaking of Strobilanthes, girdling of trees (slight).	49	6	0
1910–11	Do. do.	25	8	6
1912–13	Do. do.	68	9	0
1916–17	Do. do.	97	9	0
1917–18	Do. do.	52	0	0
1918–19	Do. do.	84	6	0
1919–20	Girdling and removal of middle storey (60 acres)	115	5	0

(iii) *Devachalla reserve.*—Two patches of 88 acres and 60 acres respectively containing natural Hopea regeneration were covered by improvement operations in 1916–17. The work consisted of removing climbers and breaking *Strobilanthes* suppressing the heads of seedlings. The patches were demarcated with a six-foot cut line and cairns along the line. These plots were surveyed. Total cost of the work was Rs. 48–8–0. The area was gone over again in the following years 1917–18, 1918–19 and 1919–20. In the last year the work was done under the supervision and advice of the Forest Research Officer. The middle storey was removed or girdled in order to admit a good deal of light. Improvement fellings were stopped thereafter. The total cost of the operations over about 130 acres during all four years was Rs. 213–15–0. Sketches of the areas showing locations were recorded in the District Forest Officer's Note-book (Volume I).

The areas also contained a number of wild jack (*Artocarpus hirsuta*) seedlings which received identical treatment.

Unregulated Hopea Sowings.

174. (i) *Kadambilla reserve.*—In compartment 9 of the Shiradi Timber Working Circle, a plot measuring 10 acres, comprising both sides of a stream, was sown with Hopea in pits six feet apart in the year 1917. The plot was demarcated by cleared lines six feet wide. There were several blanks in 1918, owing to the prevalence of *Strobilanthes*. A broadcast sowing was also made with very poor germination results, said to have been due to the heavy layer of undecomposed leaf humus over the surface soil. About 1,000 seedlings varying from " a few inches to several feet " in height were removed from the natural forest in Kidu reserve, in the following year, and 600 *Artocarpus hirsuta* seeds also were dibbled in the same area. The attempt was to all intents and purposes a failure owing to a heavy reduction of middle storey and incomplete upper canopy with heavy undergrowth of *Webera* and *Strobilanthes*, which obscured and suppressed the seedlings. *Artocarpus hirsuta* succeeded better than Hopea. The precise location of the plot is now uncertain. No subsequent efforts to sustain the crop seem to have been made.

175. (ii) *Kombar reserve.*—In 1911, Hopea was sown around the north and south sides of the compound at Kombar Forest Bungalow, and east of the Local Fund road from Gundia to Kulgunda. There were 503 surviving seedlings in 1927. The portion east of the road has been neglected, and is useful as a control. In the other two strips, 28 saplings are kept under observation, and height and girth measurements are recorded. These have been tended since 1916.

176 (iii) *Paikadamale reserve.*—In 1916, 150 Hopea transplants were put out in this reserve, in conjunction with minor improvement works to existing natural regeneration by the beat subordinates. In June 1919, 1,700 seedlings were planted out in an open grassy blank near the Local Fund road, as an experiment to see how many would establish themselves. In October of the same year there were still 1,200 healthy survivals. Mr. Currie inspected the area in March 1923 and noted that there were only 75 seedlings left, these varying in height from one foot six inches to eight feet. That officer remarked that it was difficult to believe that the plants eight feet high were only five years old, and

thought that they must have been several years old when transplanted. This may have been correct, but in view of the remarkable height increment which many seedlings in Mundaje Kap growing in semi-open maidens are now showing (several have a healthy fresh flush of two feet or more) the growth recorded is not impossible. The plot was not accurately noted for future identification, and there is now no means of locating it for certain.

177. (iv) *Kaniarmale reserve.*—About 660 seedlings were collected in June 1921 by the beat subordinate and planted in an one acre plot above the Bellary road at two miles and three furlongs from its junction with the Mangalore-Mercara road.

178. (v) *Bantaje reserve.*—*Hopea*, Mango and "Wild jack" (*Artocarpus hirsuta*) were dibbled in portions of "Coupe" I of this reserve during the improvement operations of 1920. Transplants were also put in. Mango seeds were eaten by porcupine, and the *Artocarpus* seedlings were attacked by insect borers.

179. (vi) *Yenmuru reserve.*—In 1918–19 an area of 150 acres was selected and demarcated. Operations to improve natural Hopea seedlings consisted in creeper-cutting, and breaking *Strobilanthes*, which cost Rs. 42–3–0. In 1919–20, trees in the middle storey were felled or girdled, and all brushwood and weeds removed over an area of 12 acres; the operations cost Rs. 53–9–0. Subsequent work was stopped by order of the Conservator. The Hopea seedlings were said to have greatly benefited from the work actually done.

180. (vii) *Balpa Extension reserve.*—Work described as "Improvement fellings" was begun over 150 acres in this reserve in 1916–17. The cost was Rs. 7. In 1918–19 creeper-cutting and liberation of suppressed seedlings was continued in the same area at a cost of Rs. 12–3–0.

181. (viii) *Nalkur reserve.*—The following operations were done :—

In 1912, 100 acres were treated at a cost of Rs. 55–9–6; in 1913, similar operations over 120 acres cost Rs. 47–7–0; in 1914 the work was repeated over 225 acres, and this area was demarcated by a cut line an[illegible] The above area was located between Panjipallam and Hallmajulu enclosures. In 1916–17 the 1912 area was again gone over; creepers were cut and *Strobilanthes* reduced at a cost of Rs. 31. A portion of the 1913 area was also tended, between P.R.W. IX and a line south of cairn No. 172. The work of opening up the canopy which had been done in 1912–13 was noted to have been of very doubtful value, having been too heavy; it released a vigorous growth of noxious weeds and climbers.

In 1916–17, two other plots of total extent about 200 acres were tended. These patches were located north of Yeradka and Baradka enclosures respectively. The cost was Rs. 49–6–0.

In 1917–18, tending by creeper-cutting and weeding was done over all four previous plots, the area being 320 acres.

In 1918–19 the operations were repeated over the same limits, and cost Rs. 91–9–0.

In 1919–20, the Forest Research Officer took charge of the improvement fellings, and undergrowth and middle storey were removed to admit greater light. The area treated was about 50 acres, and the cost was Rs. 136–8–6. Thereafter, improvement works were stopped, but the Forest Research staff took over certain sample plots having graduated degrees of shade removal in order to determine that treatment which gave greatest response.

182. (ix) *Bantaje reserve.*—Improvement fellings costing Rs. 25 per acre were carried out in two "coupes" in the year 1920, under orders of the Conservator, Mr. Tireman.

General Results of Hopea Improvement Works.

183. There can be little doubt that the foregoing operations were valuable as far as they went in releasing a large number of seedlings. At Nalkur these works have been followed up subsequently, but elsewhere little or nothing has been attempted in the past ten years in these areas to give further encouragement, so that the advantage gained has been minimised and even nullified. The importance of removal of undergrowth (especially *Strobilanthes*) and small climbers rather than tree shade was very properly recognized in the earlier stages of Hopea seedling growth. Girdling and felling of trees in the middle and top storeys to admit greater light has however been very irregularly carried out. In Yenekal reserve the openings made were too drastic, the gaps were invaded with thorny scandent climbers which rapidly overwhelmed the Hopea stems, and these if not actually killed have become bent and generally devoid of any leading shoot. Fast-growing species, e.g., *Macaranga Roxburghii* have come in. The work was therefore actually detrimental.

A similar mistake was committed at Nalkur and was noted upon. In Kidu, Balpa extension, and other places there is no doubt that the shade is too dense. But in this class of operations, where *annual* return to the same spot is not practicable, there is no doubt that in the majority of instances light tending with *gradual* shade removal, on a short cycle of about four years is advisable rather than drastic treatment at longer intervals.

Miscellaneous.

184. *South Mangalore Division formed.*—South Kanara district was divided into two forest divisions from 10th May 1916.

185. *Protection.*—Protection during the earlier part of the century remained very inadequate, owing to the disproportionately large size of the beats. The timber transit rules were evaded by wargdars under issue of warg permits for kumaki fuel and timber. Village revenue officials were not interested in the detection of cases. The power of dealing with offences in respect of timber removed from unreserves or kumaki detected by forest subordinates was transferred to the District Forest officer in 1919–20. Considerable improvement was noticeable towards the latter end of the period in general protection of reserves. Increase in grazing fees from July 1920 with the intention of returning 75 per cent of the revenue to graziers in the event of successful fire protection caused an immediate big increase in unauthorized grazing, without any noticeable corresponding decrease in fire occurrences.

186. *Fire-protection.*—External clearing of boundaries to a width of 12 feet, fire-tracing of road-margins, and certain rights-of-way was done annually in all the more important reserves. Certain reserves were given "special" protection and fire patrols were posted during the hot weather season. The cost of "successful" protection was between Rs. 11 and Rs. 15 per square mile. Registration of fire occurrences was consistently unsatisfactory. Protection was rendered more difficult from 1917 onwards by the seeding of bamboos; in order to collect the seed ryots often set fire to bushes and other obstacles around bamboo clumps. Attempts were made in 1920 to institute the Forest Village System for the co-operation of villagers in p[illegible]inst fire and in the regulation of green-leaf and firewood collection (see parag[illegible]

187. *Research and experiment.*—(*a*) *Sandalwood.*—Twenty-two specimens from 11 sandal trees collected from various parts of the district were sent to the Chemical Adviser of the Forest Research Institute at Dehra Dun in 1916. Analysis of oil content showed a range between 6 per cent and 10·7 per cent. The Chemical Adviser remarked:—"South Kanara sandalwood is uniformly richer in oil than any other samples I have examined till now. The opinion held hitherto as to the valuelessness of South Kanara sandalwood for want of oil is absolutely unfounded."

(*b*) *Cassia fistula* bark ("Konde").—Attempts were made in 1916 also to obtain a sale for 'Konde' bark in Madras and Coimbatore, but appear to have been unsuccessful.

(*c*) *Hopea bark.*—Six and a half maunds of Hopea bark with particulars of size and girth of trees were sent to the Tanning Expert to the Government of India, and the report received was very promising. A further consignment of 35 maunds was despatched on indent.

(*d*) Experimental seasoning of *Hopea parviflora, H. Wightiana, Eugenia Gaedneri* and *Hardwickia pinnata* was made in 1918 and 1919 under instructions from the Forest Economist at Dehra Dun. The results recorded are briefly as follows:—

i. *Hardwickia pinnata* is best converted green, but the timber is discolored and attacked in the logs by a shot-hole borer; water seasoning causes bad discoloration and fungus attack.

ii. *Hopea parviflora.*—Both green conversion and green conversion followed by water-seasoning give good results, but the latter method gives the timber a paler colour.

iii. *Hopea wightiana.*—Green conversion gives the best results. Vertical stacking is preferable to horizontal stacking, the latter method causing discoloration with tendency to borer attack. The logs were very liable to borer attack and much subject to heart-shake.

188. *Elephant capturing operations.*—(i) In 1914, a permanent double kraal was constructed near Hadikallu in Kilarmale reserve, at a cost of Rs. 317–8–4 and 18 pits were dug at a cost of Rs. 202. Mahouts lines and sheds were also constructed for Rs. 60. The pits were covered in April 1915, and four elephants fell at the end of May and beginning of June. One died two days after capture from the effects of the fall, and two others died in September of the same year from anthrax. The camp was accordingly ordered to be closed down for five years. Cattle mortality at the time was considerable in the neighbourhood. A road was constructed from Elimale towards the camp, entering Kilarmale near Paniala. The total lead was seven and half miles, but owing to desertion of the camp

only three and a half miles were actually constructed, at a cost of Rs. 559–14–7. In 1918 however, the camp was again opened and extended, there being two permanent double kraals, one temporary double kraal, and a further one under construction at the close of the year. Five captures were made. There were three working elephants in the camp and one calf born in captivity. Eighteen pits were dug during 1917–18 at a cost of Rs. 214–8–0. In 1918–19, the total cost of the operations was Rs. 2,668–13–5. In the following year eight new pits were dug, and 42 pits were covered up for the year. The total cost of the operations that year was Rs. 2,366–15–9, and three more elephants were captured. The operations were not continued after 1920.

(ii) In 1918–19, 18 pits were dug and two double kraals were made in Shiradi-Sisla reserve. There were four falls ; one elephant (a cow) died when being brought to the kraal. The others became subsequently very weak and emaciated owing to improper rationing.

The operations were discontinued in 1920.

189. *Mukkudu and Kinangai Teak plantations.*—Mukkudu and Kinangai plantations situated on the Karaingode river about 12 to 13 miles east of Nileshwar were formed in 1872. The former measured about four acres and was reported in 1874 to contain 1828 trees ; the Kinangai plantation measured slightly less than three acres in extent. Both are situated in unreserved land under supervision of the Revenue Department. Their detailed history is unknown. The plantations were thinned by the District Forest Officer in 1918, but prior to this no attention appears to have been given. Kinangai produced 31 logs of 148 cubic feet, and the yield from Mukkudu was 172 logs of 1,663 cubic feet. The produce was floated to Azhikal and sold in the following year at Rs. 1–8–0 per cubic foot. A complete enumeration was made in 1924. There were 785 teak trees in Mukkudu and 209 trees in Kinangai. Many of these were suppressed. The average girth of the dominant individuals was about 5 feet and 6 inches the largest measuring 8 feet and 2 inches at breast height. The total gross volume of standing trees amounted to 36,700 cubic feet. The plantations were sold on contract and clear-felled in 1928–29 and yielded 18,000 cubic feet of logs, or about 277 cubic feet per acre. The revenue obtained was Rs. 16,250. The chief point of interest is a sylvicultural one, in-as-much as the plantations had in the course of years of neglect acquired the appearance of a natural forest, containing an evergreen middle storey and heavy undergrowth of *Webera, Cinnamomum,* etc. Fluting and epicormic branches were notably absent, but creepers were bad. The soil was in perfectly good condition. The outturn was surprisingly good in the circumstances.

190. *The Uppinangady Teak plantation.*—The Uppinangady plantation covering four or five acres on the Netravati river bank in Uppinangady village itself is in Government land, and its history is uncertain. A Forest Overseer's quarters was probably located here. The plantation is about 58 years old. Many of the largest trees were felled after it was taken over by the Forest Department about 28 years ago. A thinning was done in 1920–21, which yielded 700 cubic feet of teak, 31 cubic feet of *Atrocarpus integrifolia,* 192 cubic feet of *Mangifera indica,* and 4,350 cubic feet of fuelwood. In 1925–26, 807 cubic feet of teak was obtained by a further thinning. The greater number are now young trees from coppice resulting from previous fellings. The undergrowth is scanty, but the land was formerly used as a depot for storing timber before floating it down to Mangalore. An enumeration was made in 1927 ; there were then 309 trees over 12 inches in girth, of which 163 were under 24 inches girth at breast-height, and only seven trees over 5 feet girth.

Hay-making.

191. As a war time emergency operation, hay-making was undertaken on a considerable scale in Kasaragod Range, for supply to the Military Grass Farm at Bangalore during the years 1917–19. The hay was cut chiefly from Government unreserves and waste lands, baled and delivered to the railway at Kasaragod. In 1917–18, some 680 tons were thus delivered ; the cost f.o.r. was about Rs. 30 per ton, which was high, owing to the wastage of 200 tons by the inability of the railway to take delivery before the monsoon. In 1918–19, and 1919–20, 605¾ tons and 619¾ tons respectively were delivered at a price of Rs. 30 per ton. There was in all a slight profit in the transactions, but forest works in Kasaragod Range were seriously interfered with.

192. *Financial results.*—Financial statements for South Mangalore Division proper start only from the date of its subdivision from North Mangalore in 1916–17, but the average receipts and expenditure for the five years 1912–13 to 1916–17 was worked out for the division and showed an average net surplus of Rs. 8,520 per annum. In 1916–17 the net surplus was Rs. 7,734. Although in the first two years of its separate existence, the receipts almost doubled themselves, yet the working of 1918–19 showed a deficit for the first time of Rs. 2,180, and in the following year 1919–20 there was a net deficit of Rs. 11,920. This was ascribable to the heavy improvement works which were begun in this division for

the enhancement of the capital value of the forests, and in pay of additional staff, including two Rangers on special duty. The removal and sale of major produce, especially of fuel, showed an increasingly favourable tendency, but there remained in 1920 a large surplus of timber and fuel unsold from the previous year.

193. *Minor produce.*—(i) Receipts from minor produce remained a very considerable proportion of the revenue to the Department. Cinnamon oil stills were leased by the Department up to 1910 or 1912 ; in the former year 150 stills were mentioned, although it is highly probable that many of these were in Udipi Range of North Mangalore Division. The right to collect produce was leased annually, the major items being Kadshige bark (*Acacia pennata*), Rampatre or wild Mace (the fruits of *Myristica Malabarica*) and *Strychnos Nux vomica*. Kadshige bark was most abundant in recently kumried areas. In 1895 the average yield was estimated at 25 tons of bark per annum from Kasaragod Range, the commodity being largely exported to Bombay, Rathnagiri, Karwar and other coastal places for the treatment or tanning of fishing nets. The trade subsequently diminished during the present century. Rampatre fruit was carted to Mangalore and shipped by Messrs. Pierce, Leslie & Co., and Messrs. Volkart Brothers to Europe, where its use was chiefly as a flavouring agent and in the adulteration of nutmegs. It was by far the most important of the products collected by the minor produce lessees.

(ii) In addition to the Nerankimale bamboo felling series, bamboo coupes were leased to contractors in Karadka, Padnur, Dadanthamale and Veerakhamba reserves. Owing to general flowering in 1917–19, bamboos were sold at seigniorage rates of Rs. 1–8–0 per 100. In 1918, 55,150 were sold, and in 1919–20, 901,660 were sold from the whole division.

(iii) Sandal was removed on a small scale from unreserves of Kasaragod Range.

III. THE PERIOD 1920–30.

SECTION 1.—GENERAL SURVEY.

194. The period has been marked by considerable changes of policy and scope in the administration of the division. It opened with no settled scheme of working for any extensive area. The Working Plan of 1902 had for long become inoperative, and Mr. Hart's scheme for the tapping of reserves bordering the Paiswani river was never put into operation with the exception of fellings in Jalsur East reserve. The district was still comparatively under-developed, and much of it remained but little known or commented upon. Past working had provided little reliable data ; control records were scanty. Simple methods of regeneration of no major species of importance (with the exception of *Hopea parviflora*) had been ascertained and adopted. Clear-felling, apart from fuel coppice, had up to the beginning of the last decade proved a failure. Departmental effort had been consumed and considerable sums spent in somewhat vaguely conceived schemes for the improvement of both the older crops and the younger crops over rather large areas with doubtless beneficial but indeterminate results.

195. Throughout the decade, yield continued to be fixed annually in the budget and the requisite areas to be felled were determined accordingly. During the first four years the output from timber undertakings averaged about 60,000 cubic feet. Extraction centres were located at Parappa, Padnur and Nalkur reserves, wherein the regeneration of *Hopea parviflora* either by natural or artificial measures was secured. The period opened badly with a general post-war depression in the timber market. Mr. Tireman, first as Conservator, VI Circle and subsequently as Chief Conservator, initiated however a vigorous policy which led to greatly intensified departmental efforts in Kanara. The policy which was begun in 1920 and brought some four years later into more visible effect, was as follows :—

(i) to regenerate deciduous forests containing appreciable evergreen ground-flora with evergreen timber species, notably *Hopea parviflora* ;

(ii) to intensify and concentrate the efforts of the staff on regeneration areas of much larger extent than had been previously contemplated, even though, as it happened, these areas were not in all cases of markedly mature age ;

(iii) the subsequent realization of all saleable trees in the top canopy in areas thus regenerated, partly for revenue and partly as a sylvicultural measure to benefit the young crop.

A period of intensive conversion ensued. In 1924–25 proposals for the annual extraction of about one lakh of cubic feet of timber were required. Mr. Madan as District Forest Officer put forward suggestions for a future 10-year period, involving the removal and conversion of about two lakhs of cubic feet. He discussed with all available data the possibilities of Parappa, Mandekole, Porkala, Padnur and Nalkur reserves. He pointed to the yet unsolved difficulties of regenerating large areas of deciduous forest, especially where evergreen undergrowth was absent or scanty. Mr. Madan also made suggestions

for a 5-year programme to be carried out in Mujur and Bantamale reserves with a proposal for further investigation of the possibilities of tapping the adjoining regions and for improving the navigability of the Kumaradhari river. Mr. Tireman had in 1923 emphasized the potentialities of South Kanara forests and the need for greatly increased staff in order to deal with heavier exploitation and regeneration measures. He even recommended with some force the operation of two extra divisions in order to cope with cultural works on a large scale.

196. In October 1925 the Chief Forest Engineer in his letter No. H. 8/5783 to the Chief Conservator submitted a memorandum covering the prospects of sleeper supplies to the railways, the wider distribution of timber sales through the services of a competent agent working in collaboration with the newly-developed Forest Utilization branch and the financial prospects of portable forest saw mills. A mill was proposed to deal with the Mangalore output. Baradka was then contemplated as the most suitable site for the mill, since Nalkur sleeper projects were just then in process of being developed following the completion of an enumeration and topographical survey by the Logging Branch of a considerable portion of high-grade timber forest. Owing to the deplorable condition of disrepair of the Jalsur-Subramania road, the task of getting the mill to Baradka was found to be too formidable, and the mill was installed at Parappa instead. It commenced work in February 1927. Two factors combined to ameliorate the circumstances of this revised setting :—

(i) the mill was able to operate throughout practically the whole year instead of merely for six months as was originally contemplated in the malarial locality of Baradka, and

(ii) a quantity of high-grade timber happened to be available in the shape of 50 to 70 years old teak in the older plantations and throughout the reserves. Parappa reserve had already been regenerated with Hopea in all suitable localities, and the mill served a useful supplementary purpose in converting quantities of small-sized material extracted in the course of sylvicultural fellings for assistance to the young crop. Unfortunately the demands of the mill went far beyond the limits of sylvicultural expediency, reacting detrimentally later upon the newly regenerated areas, by exposing certain compartments excessively to light. The saw mill was capable when working at full efficiency, of dealing with 90,000 cubic feet of logs annually and two years of working were sufficient to show that the possibilities of the Parappa location were almost exhausted. The consequent necessity for discovering fresh settings, and for developing a comprehensive working plan for the whole district caused the writer to be sent to make a detailed reconnaisance, following which stockmapping and enumerations were begun in 1929.

197. The Chief Conservator, in his No. 4027/29-C-3, dated 20th May 1929, ordered that the results of working of the saw mill should be exhaustively examined. This was done by Mr. Madan, as Conservator of Forests, VI Circle, and his conclusions were reported in his letter reference No. A-1167/29, dated 24th September 1929. It was shown therein that saw mill working at Parappa had not compared favourably with the former method of log sales, and that when future locations were considered, of which the most suitable were Sampaje and Mujur, the great preponderance of species other than teak indicated no prospect for successful operation of the mill in South Mangalore Division. The saw mill was accordingly closed down by order of the Chief Conservator at the end of the financial year 1929–30. The full objects of saw mill operation could not in any case be achieved within so short a period as 26 months, when the matter was reviewed, and it was logically arguable that neither local retail nor external markets could be effectively built up in a hurry. Nevertheless, during the period reviewed by the Conservator, only 39 per cent of the total quantity sold as scantling was of non-teak species, and total sales altogether were only 49·7 per cent of the outturn ; so that besides working at an actual loss in species other than teak, the mill had not effectively increased the saleable outturn. A summary of the mill working is given in paragraph 125.

198. The last decade has therefore seen efforts made on much broader lines than previously, in all branches of forest activity. Not least has this been so in efforts of a more concentrated nature than previously to regenerate and improve the forests. In the period 1920–30, a total extent of 4,300 acres have been felled over, 760,000 cubic feet have been logged, and 5,000 acres have been regenerated. The technique of *Hopea parviflora* regeneration, both by artificial and natural measures has received tremendous impetus, chiefly under the guidance of Mr. Madan. The extent of the annual operations allowed insufficiently for intensive supervision and discrimination in the application of method, with the result that some failures were inevitable.

199. Experiment and research has gone far but not yet far enough to establish altogether satisfactory quantitative results. It is felt that it is a pity more supervision has not been possible by the Forest Research staff. Sample plot work is rarely suitably entrusted to the un-instructed efforts of the divisional staff, which are very apt to vitiate results, or provide misleading data. In the early stages some good work was done by the Forest Research Officer, but again in certain cases the methods applied were inconsistent. Most of the plots have since been abandoned or handed over to the division. Much more investigation could still probably be undertaken.

Section 2.—Regeneration and Cultural Operations.

200. The full history of all plantations is given in the plantation journals or note books maintained by the Divisional Office in accordance with the instructions received from the Chief Conservator of Forests, in his Proceedings Mis. No. 552 of 26th October 1930. The following details are given here for general information, inasmuch as they serve to summarise experience gained. The experience derived during the period 1920–29 is of very considerable importance in future work.

I. Kasaragod Range.

(1) Parappa Reserve.

201. (*a*) *Regeneration under shelterwood.*—Prior to 1920, the suitability of many sites in this reserve for the introduction of Hopea had been recognized (vide Mr. Foulke's and Mr. Longrigg's Working Plans). Broadcast sowings by Mr. Barry about 1913 were also successful and results were favourable to the view that this species could be introduced on a considerable scale. In 1920, a start was made in the conversion of this forest from a primarily deciduous to a primarily evergreen crop, on a scale far more ambitious than any previous attempts. In the years 1920 to 1925 the entire reserve was artificially regenerated over an area of 2,074 acres. During the first two years, sowing of seeds, 8 to 10 in number, on staked patches prepared in lines cut through the undergrowth 12 feet apart, was undertaken not only with *Hopea parviflora*, but with *Artocarpus hirsuta, Vateria indica* and *Mangifera indica,* the three species last named in much smaller proportions. In 1922, the method of sowing in large pits about 4 feet wide and 1 foot deep at intervals of 27 feet apart and with 50 seeds in a pit was tried. Subsequently to this, pits were dug 12 inches in diameter and 10 inches deep at various espacements, viz., 9 feet by 9 feet, 13½ feet by 13½ feet, 19 feet by 19 feet, and 27 feet by 27 feet, placing 10 seeds in each pit. Pits were dug in advance, generally in February and March. All pits were staked. A permanent nursery of 90 beds was constructed in 1922–23, close to the Paiswani river and suitably sheltered by evergreen trees. This nursery was one acre in extent and cost Rs. 86–15–0, including fencing. Casualties were replaced annually at least twice and generally for more years in succession. Three or four seedlings were planted at each failed pit, the pits being re-dug. Weeding was carried out annually to a radius of about 3 feet around each pit. The middle storey of evergreen trees was removed over sown compartments in 1923, in the case of small seedlings up to 20 feet above ground, and over larger seedlings or young saplings completely removed, allowing shade only from the upper storey.

202. *Results of operations.*—Germination was generally excellent in *Hopea parviflora.* The effect of soil-working was beneficial. Casualties occurred during the hot-weather months. In 1925 a survey was made of areas where Hopea had not succeeded. These "failed areas" amounted to 270 acres in compartments 1 to 9, of which 116 acres were in compartment 5. These were in swampy, shallow or poor soil, grassy scrub, and mainly deciduous type undergrowth, on exposed slopes and the upper contours of the ridge.

Compartment 5 had originally been planted with seedlings on account of seed shortage in 1922 and was almost a complete failure over 112 acres. In the following year it was re-sown. The failure of these two attempts is ascribed to the very heavy "improvement fellings" which had been made in 1920, resulting in heavy coppice-growth and dense weeds, chiefly of the thorny scandent or climbing species, which choked the seedlings. The total sum spent on the "failed areas" computed at Rs. 1,021 was written off. The failed areas in compartments 1 and 2 amounting to 47 acres were again sown in 1927.

203. After the selection of Parappa as a site for the saw mill in 1927, the overwood was exploited in compartments 8, 9 and 10, to a girth limit of 3 feet for all saleable species. The openings made in the upper canopy were often severe, and Hopea regeneration suffered in consequence. Creeper growth is now heavy in these compartments and threatens to

obscure and choke the Hopea, which is becoming sparse. The Working Plans staff have roughly resurveyed the regenerated areas and the map now shows considerable fresh portions as being almost devoid of Hopea-solely, it is believed, on account of the heavy fellings made to supply the saw mill *after* the middle storey had been removed in the normal course. It is noticeable that these additional " failed areas " are to be found also to considerable extent on the reverse northern slopes, which had more pronouncedly evergreen undergrowth. Here also creepers threaten to overwhelm existing growth wherever direct light reaches the soil. The " survival statement ", made from enumerations in 1927 is therefore no present guide to results. In compartments 1 and 2, and to less extent in 3 and 4, shade on the other hand has been allowed to become too heavy, resulting in unsatisfactory height increment and casualties from drip.

204. *Other species.*—None of the other species have proved so uniformly successful as *Hopea parviflora*. *Mangifera indica* and *Artocarpus hirsuta*, if sown in the open forest were shown to suffer numerous casualties from attacks of rats, squirrels and other vermin and from insects. The germination of the latter species was, however, very good in the nursery and these were planted out to replace casualties. Even these suffered mortality to the extent cf 90–95 per cent by the following March. A small area was sown with *Hardwickia pinnata* seeds which germinated well but were very susceptible to drought. *Vateria indica* and *Hopea Wightiana* were also sown in small areas, but there is no subsequent record of them.

205. *General remarks.*—Parappa reserve, rising rather sharply to a ridge north of the river Paiswani, containing teak and other deciduous species in the overwood and with a ground flora of transitional type, might have suitably waited for a further decade before regeneration with Hopea without ill-effect. The large contiguous areas taken up ' *en bloc* ' accordingly did not permit of really desirable or adequate selection of those areas which were the most suitable for Hopea introduction, with the result that failures were inevitable. The large extent of area regenerated in a short time has also led to great diffusion of subsequent attention and difficulty in studying results compartment by compartment. There are numerous blanks even in the comparatively successful areas.

206. Adequate inspections are difficult in thick undergrowth away from inspection paths, which are not very numerous, and survivals in the areas sown at large espacements are difficult to locate. In short, some loss of control has resulted. The essential difference between control of regeneration under these conditions and under clear-felling methods, namely, the comparative ease in the latter case of assessing results in subsequent years, is well seen at Parappa, where both methods are employed side by side. In spite of the magnitude of the efforts to introduce evergreen species, areas thus sown get *by comparison* far less attention from inspecting officers than the clear felled areas, for no officer has the time at his disposal necessary fully to ascertain results in dense undergrowth, without there being numerous inspection paths throughout the forest in all directions. This difficulty is accentuated when extensive areas are taken up within a short time, all such areas requiring detailed sylvicultural attention for a period of many years subsequent to sowing, which operation on account of its mechanical nature is the least complex of any.

207. The future prevention of extensive " failed areas " ought to be possible after our experience in Parappa and other reserves of sowing up large contiguous blocks, by better selection beforehand of those localities where Hopea can reasonably be expected *not* to fail, and by the exclusion of doubtful or unsuitable sites either until a later period or for regeneration by other methods.

It is manifest that the intimate knowledge of Hopea-regenerated compartments so necessary in order to achieve the best results, is only obtainable by long experience ; frequent changes of staff are therefore undesirable.

208. The following table shows the cost of operations up to 1929–30 exclusive of fire-protection or overhead charges. Owing to the large number of casualties replaced (especially in the second year), the total costs of the first two years are included under " formation."

Year of sowing.	Compartment number.	Area.	Espacement.	Cost of formation.			Cost of tending.			Total cost.			Cost per acre.		
			FEET.	RS.	A.	P.	RS.	A.	P.	RS.	A.	P.	RS.	A.	P.
1920–21	7 and 8	444·8	12 × 12	1,382	15	4	1,035	12	8	2,418	12	0	5	7	0
1921–22	9 and 10	331·0	12 × 12	1,314	6	3	399	5	3	1,713	11	6	5	2	6
1922–23	1 and 2	525·6	27 × 27	1,332	8	9	712	2	3	2,044	11	0	3	14	2
1922–23	3 and 4	358·2	13½ × 13½	1,078	14	6	882	9	8	1,961	8	2	5	7	7
1923–24	5 and 6 (part).	342·0	19 × 19	920	6	7	750	12	8	1,671	3	3	4	11	10
1924–25	6 (part)	72·5	9 × 9	614	8	8	134	13	0	749	5	8	10	5	4

209. (*b*) *Clear-felling and regeneration with deciduous species.*—The following notes are in more detail than is commonly given, since they refer to the only serious efforts made

by the department in this district to clear-fell and regenerate with deciduous species, apart from the treatment of fuel areas. The operations were in fact experimental.

210. *Compartment* 6.—1923–34 plantation (15·9 acres). This plot was considered unfit for Hopea regeneration being near the crest of a ridge and having deciduous type undergrowth. It was clear-felled at the beginning of the calendar year 1924. Seeds of various species were sown in pits spaced 9 feet by 9 feet as follows :—Teak (5 acres), *Dalbergia latifolia* (3 acres), *Xylia xylocarpa, Lagerstroemia lanceolata, Terminalia tomentosa,* and *Pterocarpus Marsupium* (2 acres each). Total number of pits sown was 8,592. Survivals in 1925 were 3,405. In addition, however, there had come up 4,045 natural seedlings, root suckers and coppice shoots, of which 930 were *Dalbergia latifolia,* 955 *Schleichera trijuga,* 890 *Tectona grandis,* 760 *Largerstroemia lanceolata,* 435 *Xylia xylocarpa.* A dense growth of shrubs and climbers had also appeared. One weeding was given in 1924 and one in January 1925. In 1925–26, two weedings ; in 1927 one " tending " was done ; subsequently nothing until a climber-cutting in 1930. The Conservator's remark on this area in October 1927 was :—" The results are most disappointing, these species seem most unhappy, and we shall make nothing of them." *Trema orientalis* and *Macaranga Roxburghii* have covered the area and there is an almost impenetrable under-thicket of deciduous and evergreen species. The total cost of formation and tending up to October 1930 is Rs. 18–11–0 per acre.

211. *Compartment* 8.—1926–27 plantation (area 23 acres). This area is also on the ridge. Clear felled in 1925–26 and twice burnt over in May 1926, 15 acres were sown with teak, and 8 acres with *Terminalia tomentosa,* in pits 9 feet apart. Two weedings were given in 1926, sparing coppice shoots and root suckers, of useful species. Teak survivals were low. The area was reburnt in 1927 ; scorched seedlings were cut back. Blanks were sown with *Acrocarpus fraxinifolius, Gmelina arborea, Terminalia tomentosa,* and a little *Lagerstroemia. Acrocarpus* germinated to an extent of about 20 per cent after a few days but was badly attacked by a lepidopterous larva. *Gmelina* germinated to an extent of about 80 per cent but was browsed by sambhur. *Terminalia* showed about 60 per cent germination. The area was thrice weeded in 1927. In July 1930 there were a number of blanks filled with *Xylia* thicket or *Strobilanthes.* Teak seedlings had reached an average height of 15 to 25 feet. Adventitious growth of teak and *Terminalia* coppice was good. Pruning, tending, and climber-removal was done in 1930. A large number of natural seedlings and root-suckers of *Dalbergia latifolia* (515), *Xylia xylocarpa* (411), *Pterocarpus Marsupium* and other species have helped to restock the area.

The cost of creation and upkeep were—

	RS.	A.	P.
Cost of formation (1926–27)	317	2	11
Reburning, re-sowing and weeding (1927–28)	239	8	5
Weeding (1928–30) and general tending	96	2	5
	652	13	9
Total average cost per acre at the end of fourth year ..	28	6	5

212. *Compartment* 9.—1929–30 plantation (area 16 acres). The area was ordered to be clear-felled and regenerated in January 1929. Early rains impeded burning. Teak and *Acrocarpus* seeds were sown in May 1929 in pits 6 feet apart, 10 to 12 seeds per pit, *Acrocarpus fraxinifolious* being sown in rocky portions over 2½ acres.

Dalbergia latifolia seedlings were planted along the three outer rows adjoining the edge of the plantation. Casualties amongst teak amounting to 50 per cent were replaced in June 1929, and by stumps from nursery seedlings in June 1930. The area is a hot, rather steep, exposed, southern slope near the crest of the Parappa ridge, with soil turning to laterite at the lower end of the coupe, where teak casualties were most numerous. There are few *Acrocarpus* survivals. *Dalbergia* has survived fairly well. The cost of formation was Rs. 450–6–0, i.e., Rs. 28–5–0 per acre, and tending in 1930–31 cost Rs. 3–13–0 per acre.

213. *Compartment* 5.—1930–31 plantation (area 30 acres). Felling was done in January–March 1930. The plot was burnt 3 times in April. Teak was sown in pits 6 feet apart. *Pterocarpus* and *Dalbergia latifolia* were sown in the outer three rows. There were three weedings in 1930. The percentage success of teak in October was 80. *Pterocarpus Marsupium* and *Dalbergia latifolia* seedlings are healthy. Teak failures were chiefly on heavily burnt patches retaining a quantity of white ash ; here also casualties were numerous amongst replacements. Casualties also occurred on low-lying stiff soil. *Dalbergia latifolia,*

Terminalia tomentosa, *Terminalia paniculata*, and *Schleichera trijuga* appeared spontaneously but few *Xylia*. Half an acre on the crest of the hill was sown with *Xylia*. Drains were dug on the slopes of the hill to prevent wash. First year costs are anticipated to be Rs. 30 per acre. The area promises well. Soil and situation are similar to the 1926–27 plantation adjoining.

214. *Summary*.—The following conclusions are arrived at—

(i) The crest of a hill is not normally a site particularly suited to teak, but the soil in compartments 5 and 6 was a fairly good, deep loam, moderately light and well-aerated supporting originally a good deciduous crop. The soil in the eastern compartments (8 and 9) was not so good, becoming distinctly laterite in compartment 9. The last-named was also a very steep hot exposed slope and has not proved ideal for teak.

(2) The value of a good burn is obvious. The heavy weed growth on the 1926–27 plantation (compartment 6) was probably the result of an inadequate burn. The reburn in compartment 8 was an expensive matter; the growth of teak however does not appear to have suffered conspicuously by having been burnt and cut back. On the other hand, fierce burns resulting in heaps of white wood-ash are definitely detrimental to success in these patches during the first year, and so should be avoided.

(3) Adequate weeding and tending during the first few years until the teak has reached a height of 25-30 feet with closed canopy is all important. Parsimony in this direction has led to failure. The 1926–27 plantation very clearly shows the result of inadequate attention.

(4) Clear-felling has shown that a large number of good species are reproduced spontaneously as seedlings or root-suckers. These continue to appear for several years subsequent to the burn. *Xylia* is often slow to appear but may afterwards tend to form a vigorous thicket in areas suited to this species. Coppice growth, although retarded by the burn is usually strong. This natural regeneration is a useful *supplementary* crop.

(5) Teak has invariably done well on the sites of burnt bamboo clumps. This is probably due to the very porous nature of the resulting soil. Soils on the whole are moderately light and well aerated, but may need working up at lower levels or near small nullahs.

(6) The best patch of teak regeneration in compartment 8 occurs on sloping ground containing a high proportion of gneissic boulders and outcrops. This is interesting and indicates that this type of soil is not necessarily unsuited for artificial regeneration by this species. Natural teak occurs in almost identical localities in Sampaje.

215. (ii) *Aletti West reserve—Natural Hopea region*.—An area of about 250 acres in this reserve was felled and regenerated in the years 1928–30. Although the original crop was over-mature like that of Jalsur East (vide paragraph 216) it was of a more pronounced evergreen type. It differed also from Jalsur East in having somewhat sparse regeneration of Hopea, the shade being far too dense to encourage growth of this species in the younger stages. Advance-growth up to 20 feet height existed only in small groups. The year 1927 was a good seed year and it is a pity it could not have been utilized to more advantage by some opening-up of canopy in the middle and top storeys. About 20 acres of "Coupe I", contained natural regeneration which was tended after fellings. The gaps caused by the fellings were usually not excessively large. Artificial regeneration over 35 acres of gaps was done with Hopea, *Artocarpus hirsuta*, and *Acrocarpus fraxinifolius*, partly by sowing seeds (9½ acres) and partly by transplanting seedlings (25½ acres). Artificial sowings of *Hopea parviflora* were a comparative failure, but transplanted seedlings survived, although small. *Artocarpus hirsuta* in the more open places has been conspicuously successful and appears to be ideally suited to the conditions. Hopea also has a healthier appearance in the comparative open, these slopes having a northerly aspect. *Acrocarpus fraxinifolius* (over 1½ acres) has not progressed very satisfactorily and shows signs of having been browsed. Undergrowth and middle storey have been decisively reduced but the latter where girdled has not yet died everywhere. The cost of regeneration in "coupe I" (1928–29) over 55 acres up to November 1930 has been Rs. 11–6–0 per acre. In "coupe II" (81 acres) lines have been cut through the undergrowth where natural regeneration is sparse, the lines being 3 feet wide and 9 feet apart. Hopea was here sown in pits at stake. The cost of first year operations have been hitherto Rs. 3 per acre; work is still proceeding. Artificial regeneration might have been much reduced had it been possible to utilize former good seed years.

216. (iii) *Jalsur East reserve*—(*a*) *Natural regeneration area* (147·3 *acres*).—The fellings in this area in 1915–16 released a copious quantity of seedlings and advanced-growth.

Subsequent works were conducted with the object of letting in more light by felling and girdling remaining useless or soft-wooded species, most of which were splendid *Eugenia Gardneri*.

In 1920 the Conservator Mr. Fischer, noted as follows :—" In Jalsur East the original opening was insufficient and this was pointed out by Mr. Tireman. The subsequent opening has been rather more severe perhaps than Mr. Tireman contemplated, or at least described, but I do not consider it more than the crop can stand ". In 1922, Mr. Tireman inspected the area and remarked, " In my inspection note written in November 1919, I stated that the improvement felling (which it would be more correct to call a 'secondary felling') had not been carried out with sufficient severity and ordered that more shade must be removed from the young Hopea. This has since been done with most wonderful results. We have now about 175 acres covered with a crop of young Hopea up to 5 or 6 feet in height within many places 10 to 15 thousand seedlings per acre. In addition to Hopea there is also a very fine crop of Billithirpu (*Eugenia Gardneri*) . . . In one place there is a patch of Hebbalsu (*Artocarpus hirsuta*) about half an acre in extent ; from a height it is impossible to see the ground through the canopy of leaves of the seedlings which are 5 or 6 feet high."

217. Unfortunately the removal of practically all overhead shade released a luxuriant growth of herbaceous and fast-growing woody species which have since required very rigorous attention in order to prevent it from choking the Hopea crop. It is certain that although the Hopea thickets have survived, there have been a very large number of casualties among this specious especially the younger individuals. The thicket of useless species, very largely *Leea* (*sambucina*), grows to a height of 12 to 15 feet, while *Macaranga*, *Trema*, etc., are also most difficult to keep in check, and interfere with the delicate leading shoots of Hopea. The Hopea itself does not appear entirely healthy, having a branched or bushy appearance in manv cases, and is apparently not putting on much height increment. In the writer's opinion, the almost full incidence of sunlight on the young crop has had the following results :—

(*a*) Stimulation of germinating seeds and a satisfactory response in the very early stages, followed by—

(*b*) an unanticipated vigour in the growth of undesired herbaceous species to a height treble or quadruple that of the same species under canopy. These species have far outstripped the Hopea crop in rapidity of growth.

(*c*) There has been a noticeable retrogression towards a more deciduous type of flora springing up in place of the old crop.

(*d*) Numerous casualties amongst both Hopea and *Eugenia Gardneri*, either from excessive exposure (not entirely proven) or from interference and occlusion by the luxuriance of other growth. The almost total loss of *Eugenia Gardneri* is a pity. This species also reproduces itself in dense thicket under partial shade, it is a natural associate with Hopea, grows at approximately the same rate and is helpful in drawing up the other seedlings.

(*e*) Excessive sunlight does not appear to have been necessary or desirable for Hopea and would appear to have retarded height growth and aided a branchy habit.

(*f*) The cost of subsequent tending has been in consequence higher than that of any *artificial* regeneration works elsewhere. The cost of establishing the crop during the first ten years 1916–17 to 1926–27 was as follows :—

	RS.	A.	P.
i. Cost of initial regeneration per acre	1	15	5
ii. Cost of tending operations	29	15	7
Total up to 1926–27 ..	31	15	0
	per acre.		

218. The following extract is made from the inspection note of Mr. Richmond in Chief Conservator's Proceedings No. 63, Press, dated 22nd February 1924 :—" About 12 annas per acre has been spent in 1923, and expenditure on account of natural regeneration alone, since the inception of the felling operations in 1915, has amounted to Rs. 4,000 or Rs. 27 per acre. It is difficult to understand how it has been found possible to spend any such sum and it may be that bad accounting has included some of the conversion charges with the amount spent on regenerative measures. The end of the expenditure is not yet in sight and it is to be feared that clearings, creeper cuttings and weedings will be required for several years to come, over most of the area ; it being a point for consideration in connection with future work of this class whether it will not be better to open up more gradually, and thus, though perhaps losing a very little height growth to save not only in expenditure but in supervising staff required for work elsewhere."

219. The Working Plan staff have endeavoured to indicate on the detailed map for Jalsur East included in the Timber Working Circle the present stages of regeneration from the point of view of density and height-growth. Attention is still required in order to free the heads of young plants from surrounding growth, which is 12 to 14 feet high, and height increment is rather slow.

220. (*b*) *Artificial Regeneration.*—The artificially regenerated area is 252·5 acres, partly in compartment 1 and partly in compartment 2. Work commenced in June 1917 by broadcast sowings of Hopea, *Terminalia tomentosa* and *Pterocarpus Marsupium*. The two last-named species failed, and Hopea was reported in 1918 to have suffered somewhat in places from excessive exposure, but elsewhere was " extremely vigorous." About 5 acres unsuccessfully regenerated were planted with 8,000 seedlings from unreserves. Dibbling with Hopea, *Artocarpus hirsuta, Mangifera indica* and *Vateria indica* in 1920, in areas where Hopea was absent, resulted in gratifying success of the first-named, but Mango and Aini (*Artocarpus*) were destroyed by the usual pests. In 1921–22, 125 acres of compartment 2 were sown, 100 acres with Hopea in lines at 12 feet by 12 feet espacement, 25 acres with *Artocarpus hirsuta*. In 1922–23, undergrowth to 25 feet high was removed. Failures in areas thus liberated were reported to be less than in areas where undergrowth was not removed. In May 1928, casualties were reported to be 13 per cent, a gratifying result on the whole. In 1930, after weeding, the crop has a very healthy and clean appearance. The retention of reasonable upper canopy of tall trees is evidently beneficial, and the young Hopea stems are now putting on very satisfactory annual height increment of between 1 foot to 2 feet 6 inches. There is a noticeable difference in growth-habit between these and the crop completely exposed to sunlight in the naturally regenerated areas. Total height varies from 6 feet to 15 feet. *Artocarpus hirsuta* is approximately of the same height. The cost of establishing the crop up to November 1930 is :—

	PER ACRE. RS. A. P.
Cost of formation in 1930–31	6 1 10 per acre.
Cost of tending	10 11 0 per acre.
Total ..	16 12 0 per acre.

Mr. Richmond, as Conservator, VI Circle, in his inspection note of 1924 above quoted, recorded the following note :—" The first step taken in the interests of young Hopea was to girdle or fell all trees up to 25 feet in height ; this was done over 150 acres in 1922 and in 1923, the whole area was gone over on the principle of felling or girdling trees up to 2 feet in girth. The expenditure to date has amounted to Rs. 7 per acre. The opening this year (1924) has been far too intense. Little discrimination was displayed when the work first commenced, and the result, over a part of the area, is that there are some practically clear-felled patches ; a very grave mistake, for Strobilanthes and weed-growth has come in and will give trouble. The fact is that it is impossible to prescribe any density or degree of felling to be carried out. The conditions of shade and stocking naturally vary from acre to acre, and the whole matter becomes one of skilled marking and cannot be done by rule-of-thumb. For this reason the areas undertaken year by year should not exceed the ability of the District Forest officer or a trained assistant to supervise personally."

These remarks have a general application, and the necessity for skilled individual cultural attention is felt in almost every one of the operations dealt with in this plan.

II. Uppinangady Range.

Porkala and Padnur Reserves.

221. In the Shiradi Working Circle, no artificial replacement of crops was effected. Between 1911 and 1916, some 10 acres were sown with deciduous species and a little Hopea and *Artocarpus* was put in by subordinates.

Systematic sowings of evergreen species, prior to felling were begun in 1920-1921 and continued until August 1924. Various espacements and methods were applied. In the first year lines were cut 3 feet wide through the undergrowth at 12 feet intervals and seeds dibbled to one side of the lines in uncut forest, the object being to minimise browsing. The tendency was for the cut lines ultimately to coincide with the line of seedlings, however. In the following year, large pits of 3 feet diameter were spaced 27 feet apart in Porkala reserve and about 50 seeds were sown in each pit. The espacement was reduced in 1924 to

9 feet and the surplus seedlings (sometimes 40 at a pit) were utilized by transplanting. In other areas pits 1 foot in diameter were prepared in each of which 10 seeds were sown. The espacement varied from 9 feet to 13½ feet. About 70 acres were sown with *Artocarpus hirsuta*. As at Parappa, uniform regeneration of large contiguous areas did not permit of adequate selection and a number of patches subsequently proved unsuited for Hopea. These were generally on higher ground with deciduous undergrowth. The area considered unfit was 155·9 acres. The net area subsequently maintained was 1,463 acres.

222. Tending of the young crop commenced in 1922. The whole area was gone over in 1924–25 and casualties replaced. Tending operations consisted in replacing stakes, weeding of undergrowth to a radius of one foot around seedlings, removal of middle storey where dense up to 25 feet height, subsequent cutting of coppice growth, and soil-working. Casualties were replaced for two years only. Second removal of all inferior species up to 25 feet in height was done in 1927–28, and had a markedly beneficial effect. Bamboo seedlings needed up-rootal in sown areas, but this has not prevented the growth of bamboo along the edges of plantations. Climber cutting and release of seedlings has continued annually down to the current year.

223. Concurrently, timber fellings were started in Padnur reserve in 1922–23 over the 1920–21 sown area, and were continued until 1929–30 in both reserves. Some damage to Hopea seedlings during felling and dragging was inevitable. A counting of damaged seedlings showed about 7 per acre, or about 2 per tree felled, which is a very satisfactory average. Fellings, however, were light and the trees not large.

On the whole the regeneration works have shown more satisfactory results than at Parappa, due largely to the retention of sylvicultural methods. The operations have also resulted in a copious regeneration of *Xylia xylocarpa* throughout the area. The ground-flora is more nearly ideal for Hopea introduction than at Parappa. *Leea sambucina* and other tall-growing weeds have become thick wherever there are perceptible gaps in the canopy. The former species seems in places to have eliminated the Hopea in Porkala 1922–23 sown area which at one time was the most successful. The height of Hopea seedlings is generally between 5 feet and 25 feet ; the average in the 1920–21 sown area is about 15 feet. *Artocarpus hirsuta* suffered casualties in early youth and was also browsed. Survivals are either suppressed and weakly, of about 5–6 feet height, or in more favoured localities have reached 30–35 feet and are fine thrifty poles, of about 18 inches girth at B.H.

224. A statement is given below showing costs of creation and upkeep to the present year (1929–30).

Reserve.	Year of plantation.	Species installed.	Espacement.	Area maintained.	Expenditure.											
					Formation.			Tending.			Fire protection.			Total.		
			FEET.	ACS.	RS.	A.	P.	RS.	A.	P.	RS.	A.	P.	RS.	A.	P.
Porkala ..	1920–21 ..	Hopea, Artocarpus Mango, Vateria.	12 × 12	216·5	325	11	0	819	12	0	136	0	0	1,281	7	0
	1921–22 ..	Do	12 × 12	20·0	323	8	0	252	1	0	13	2	0	558	11	0
	1922–23 ..	Hopea, Artocarpus.	27 × 27 and 9 × 9	475·0	3,351	1	0	1,800	7	0	297	0	0	5,448	8	0
	1924–25 ..	Do.	9½ × 9½ 9 × 9	50·0	711	2	6	209	1	0	27	5	6	947	9	0
Padnur ..	1920–21 ..	Hopea, Artocarpus Magnifera, Vateria.	12 × 12	204·0	168	4	0	820	7	0	146	4	0	1,134	15	0
	1921–22 ..	Do.	12 × 12	29·5	405	14	0	338	4	0	20	0	6	764	2	6
	1922–23 ..	Hopea, Artocarpus.	13½ × 13½	408·3	2,087	4	0	1,470	14	0	223	2	0	3,781	4	0

Nerankimale Reserve—Clear-felling with natural and artificial regeneration.

225. This forest has been worked for bamboo under the 1902 plan and for fuel and small timber since the year 1911–12.

It was originally worked under the method of " coppice with standards " up to the year 1918 ; a method of selection felling called " thinnings " was substituted thereafter until 1922. A change to " simple coppice " was made by order of the Chief Conservator and has been continued since 1922–23. The produce has been felled and removed both departmentally and by contract, the latter agency having been found convenient since 1921–22. Contracts originally extended to March 31st. Owing to the necessity for frequent extensions of voidah, difficulty was experienced in achieving a satisfactory burn in the same year. Latterly therefore, no attempts were made to burn the area. In 1923, a report stated that burning had stimulated the growth of coppice-shoots to " an almost undesirable extent " (sic). In the 1923–24 coupe (No. 12 of compartment 3) half the coupe about 20 acres remained unburnt, but the area became satisfactorily restocked, having few blanks. In the later coupes it is apparent that whether or no the slash was burnt after felling, weeds have succeeded in gaining an undesirable hold, except in the places

occupied by good coppice growth. Climbers especially *Hybiscus* are very troublesome. Burning the area provides a set-back to weed-growth but does not eliminate it as a competitor with regeneration of seedling and root-suckers, unless afterwards kept vigorously in check. General practice has been to sow seeds of deciduous species in prepared and burnt patches wherever coppice regeneration was sparse. The species sown were *Terminalia tomentosa* and *Pterocarpus Marsupium*. In coupe 13 some teak seed was sown after soaking previously for 48 hours, but the results were not encouraging. Sowing has been of doubtful value, since the location of these patches is rapidly lost sight of in the surrounding undergrowth which rapidly overwhelms them if neglected. First year tending has consisted in hacking inferior coppice and cutting climbers ; casualties are replaced in the second year usually with *Terminalia tomentosa* seedlings. Subsequent tendings, consisting of thinning out coppice-shoots, cutting back useless species and freeing seedlings for about 3 feet around each, has in recent years been too light, costing about 6 annas only per acre per annum. Total costs of regeneration have varied from Rs. 8 to Rs. 20 per acre, including fire-protection.

Records for this series of coupes have not been kept in great detail, owing perhaps to the small importance ascribed to fuel coupes in general. The old " coppice with standards " system does not appear to have been ill-adapted to this type of forest, but did not succeed in keeping down weeds. In the coupes worked under this system, it is apparent that seedlings of desirable species were for a time suppressed, but since partial closing of canopy among the standards, weeds have been reduced and seedlings are again establishing themselves under the canopy.

Mujur Reserve—Regeneration in gaps and under shelterwood.

226. This work was started in May 1930 in an area chiefly of moist deciduous type. Extraction by the usual method of selection fellings was completed prior to regeneration. Natural regeneration was sparse owing to evergreen undergrowth. *Terminalia* regeneration appeared in the grassy outskirts of the compartment ; *Xylia* with some *Dalbergia latifolia* advance-growth was in evidence on knolls and ridges. In moister regions *Artocarpus hirsuta* regeneration appeared in company with *Xylia*. The method adopted to regenerate the compartment was accordingly varied and experimental but was primarily a " group " method having the object of regenerating the gaps made by the fellings. In some of the larger gaps teak and *Pterocarpus Marsupium* seeds were sown after burning the slash. About ten seeds were placed at prepared patches spaced 9 feet apart. The total area of these gaps thus regenerated was only 1½ acres. Other gaps containing evergreen undergrowth were regenerated artificially with Hopea seedlings of a few months old. Over 22 acres in more pronouncedly evergreen portions Hopea was transplanted in lines 9 feet apart. A climber cutting and a tending operation to free existing natural regeneration was conducted throughout the area. Results cannot be accurately foreseen at present. The method approaches most nearly that proposed in Part II of this plan for the Timber Working Circle. Estimates of costs are more difficult to arrive at than by more uniform methods of treatment and require that the area be carefully examined beforehand. Prior detailed examination of these forests is however a desideratum in the interests of efficient management, and can hardly be dispensed with. The total cost of the above operations in the first year of formation, including cost of nursery but not special fire protection, and overheads, was Rs. 275–2–6 or Rs. 1–12–5 per acre on the entire area.

III. Puttur Range.

Nalkur Reserve—Natural Hopea regeneration areas.

227. *Compartment* 1.—The locality bore considerable resemblance to Jalsur East Reserve in that it contained a good stocking of mature *Hopea parviflora*, *Eugenia* and other associates, and natural regeneration of these species was plentiful. Up to the year 1920, about Rs. 1,000 had been spent in improvement operations to free the young crop, by girdling inferior species, breaking *Strobilanthes* and climber cutting. In 1921, the whole reserve was divided into six improvement felling " coupes," each of about 1,000 acres. The area now designated " Compartment " but hitherto known as " Coupe I " of area 1,106 acres, was first taken up for intensive improvement work. Lines through the undergrowth were cut 4 feet wide and 16 feet apart in order to free Hopea seedlings along them ; trees under 40 feet in height, other than valuable species, were girdled or felled ; the entire coupe was fire traced. Regrowth in these lines has been kept clear during subsequent years. A topographical enumeration by the Logging Branch was made of all saleable trees of and over 5 feet in girth at breast-height in 1924–25. Thereafter up to the year 1929–30, timber fellings have been conducted in this compartment alone. A shelterwood of non-marketable species has been left, over the majority of the area. The

limits of each year's working are not always very clearly defined, separate valleys or portions of valleys having been tapped as convenient. This is felt to be a disadvantage, but is of small consequence in the matter of cultural tending of the young crop, since the existing regeneration varies in degree, not according to annual coupes, but from patch to patch over the entire area of the compartment. The area was in 1924–25 divided for purposes of classification and treatment into three classes according to the state of advancement of regeneration of useful species, chiefly Hopea. "Class 1" areas contained Hopea seedlings in abundance, a perceptible proportion being already high enough to have their heads free from hindering weed growth. "Class 2" areas were not so adequately restocked, but still contained a sufficiency of seedlings (generally 1 to 2 feet in height) along the cut lines to form a fairly close canopy in future years. "Class 3" areas were those which did not contain a sufficient number of seedlings along the cut lines alone to ensure a satisfactory degree of future stocking, but search in uncut forest revealed enough to make a reasonably good future crop if suitably tended.

228. In "Class 1" patches, therefore, tending was limited to the cutting of coppice shoots, creepers and overhanging branches where necessary to release the heads of seedlings. "Class 2" patches were treated more intensively along the cut lines, all growth on these lines being reduced almost to ground level. In "Class 3" areas, lines were not maintained, but about 200 seedlings per acre were selected to give an evenly distributed future stocking, and undergrowth around each was cut back for a radius of 2 feet. Estimation of the respective areas to be thus differently treated is found to be difficult, as also is the task of differentiating on the ground between second and third class areas. Nevertheless the object was fairly well achieved and aided discriminatory apportionment of expenditure. Total expenditure in first-class areas (200 to 240 acres) during the years 1924–25 to 1927–28 amounted to an average of only Re. 1 per acre, or 4 annas per acre per annum. In 1928–29 and 1929–30 no work was done to these portions. During the same period (1924–27), total expenditure in second-class areas (about 300 acres) amounted to Rs. 2 per acre approximately. The original cost of line cutting in 1923–24 cannot be properly calculated for second-class areas only, but would be in the neighbourhood of Rs. 1–8–0 per acre. In 1926–27, the 4-foot lines in second-class areas were widened to 8 feet over 200 acres, subsequent to which the expenditure has been small. In third-class areas (about 150 acres) the work of selecting about 200 evenly distributed seedlings per acre, staking them and clearing weed growth around each seedling cost about Rs. 2–10–0 per acre, or an average of 10 to 11 annas per acre per annum. The above figures are only approximate, as the areas included in each class are only roughly known and have varied slightly from year to year. From a survey made in 1929, the following figures of areas were obtained which would indicate that previous estimates of the extent of class 1 areas were too large, or else that a portion had not been benefited by the treatment :—

	ACS.
First-class areas—total	89·2
Second-class areas—total	470·9
Third-class areas—total	207·3
Total ..	767·4

The total expenditure over 650 to 700 acres in compartment 1 from 1924–25 to 1929–30 inclusive was Rs. 2,045 or a trifle over Rs. 3 per acre, distributed as follows :—

	RS.	A.	P.
(i) Aligning and staking	209	5	6
(ii) Line cutting and clearing regrowth	1,223	6	11
(iii) Creeper cutting	155	10	7
(iv) Removal of middle storey and overhead shade ..	120	13	6
(v) Fire protection	334	13	0
Total ..	2,044	1	6

Prior to felling operations begun in 1924 for the removal of the mature crop, a sum of Rs. 5,321–6–9 had been spent in preparatory operations, so that the total expenditure over about 767 acres in compartment 1 amounts to an average of Rs. 9–10–0 per acre.

229. A comparison with the costs of tending in similar natural regeneration areas of Jalsur East Reserve shows how abundantly the methods used here have been justified. Weed-growth, however, has not been kept down to the extent desirable and tending works have been too light during the past two or three years. In such admirable conditions for the rapid establishment of a good Hopea crop, a greater expenditure is justifiable where it can be appropriately employed. Where the top canopy has been drastically removed,

weed-growth not very dissimilar from that of Jalsur East has gained the upper hand. In exposed class 2 areas, the undergrowth on either side of the cut lines has closed over to form a ' roof ' which interferes with the proper development of the leading shoots.

230. Certain localities are almost devoid of Hopea regeneration or advance growth, and here it might have been possible to supplement by artificial sowings and transplants from more abundant areas. In the writer's opinion, little should be done yet in the further removal of top tree canopy, except on northerly or shady slopes, where young Hopea crops exist in sufficient number and state of advancement to warrant it ; generally they are sparse in such places.

231. *Compartment* 2.—This locality is of a more deciduous nature than compartment 1, and less abundantly stocked with young Hopea and other valuable evergreen crops. Nevertheless, identical treatment with that given to compartment 1 was possible. The only variation in method has been to cut 8-foot wide lines through first-class areas instead of tending throughout. This was done in accordance with Chief Conservator's instructions in November 1926. All operations here have been in the nature of advance preparatory works, since felling of the mature crop begins only from the current year.

232. The total area of the compartment is 1,220 acres, but close regeneration of Hopea and *Artocarpus* covers only about 496 acres. The total sum hitherto spent on line-cutting and weeding has amounted to Rs. 2,832–7–9 at the time of writing ; or approximately Rs. 5–11–0 per acre. Removal of middle storey has not been undertaken. Tending since 1926–27 has been very light.

233. Comment is needed on the manner of cutting lines. These have been arbitrarily spaced and the work carried out by a forester. In some lines in poor second-class areas the Hopea seedlings exposed have been very few, hardly justifying a line clearance, whereas in the uncut intermediate spaces, struggling *Artocarpus* or Hopea individuals are left entirely untended. The method in such cases is uneconomical and discrimination is needed. It is in fact most difficult to tell in advance whether such an area should properly be treated as second or third class regeneration, and the cutting of 8-foot wide lines blindly through the undergrowth is obviously not justified until a superior officer has satisfied himself that the work is remunerative. Again in 1927–28, no work was done to first and second class areas, the result in some cases being that original lines became obscured in places, and when in 1928–29 they were re-opened, the original lines were not easy to follow, so that work was probably to some extent wasted.

IV. Beltangady Range.

Mundaje Kap—Artificial Sowings of *Hopea parviflora.*

234. Two areas of 277 acres and 138·25 acres were sown and planted with *Hopea parviflora* in 1926 and 1927 respectively. All methods, viz., sowing, broadcasting, dibbling seeds in pits, and planting transplants, were employed. A small plot of 1·6 acres was planted with *Artocarpus hirsuta* seedlings raised in a nursery. The whole reserve is a poor type of moist deciduous forest containing however a heavy undergrowth of *Webera* and *Psychotria truncata* with a perceptible middle storey of evergreen species. A test enumeration over the 1926 plantation carried out in 1927 showed that the percentage of success was between 54 per cent and 90 per cent. Casualties were replaced as usual for two years with 1-year old seedlings from the nursery. Seedlings from various localities had been used in the year of formation. In 1928–29, the District Forest Officer observed that local nursery seedlings had fared best ; those from Parappa nursery were the next best, and portions planted with seedlings from private " hadis " were the worst, casualties in the last-named being nearly double those in the other two portions. Seedlings in 1928–29 were found at 90 per cent of the stakes. The *Artocarpus hirsuta* plants were not putting on appreciable growth.

When inspected by the writer in 1930, it was particularly noticeable that seedlings sown or planted in semi-open grassy areas were the biggest and healthiest, often treble the height of those under heavier shade. They were also free from climbers. New leading shoots had grown 1 foot 6 inches to 2 feet 6 inches during the current season. These specimens, introduced generally under the partial shade of bushes in the same manner as sandal would be, had a healthy sturdy appearance in contrast with the small spindly stems of those under shade. Very similar results have been noticed in identical situations in North Mangalore Division, and it is apparent that the method will in many moist situations be an ideal way of restocking blank grassy areas, provided there is some bushy or scrub-growth present. Weeding the grass from around these individuals appears to have a good effect.

The inference is that the canopy should be opened out in the rest of the forest but at the same time experience points to caution in this respect.

235. The sample plots laid out with the object of comparing results of seedlings from various localities are quite useless for this purpose, being situated in widely different portions

of the forest, under manifestly varying conditions. No measurements in such circumstances can be of the slightest comparative value, for the purpose intended. Unless there is a lower impermeable " pan "—which is not unlikely—the future crop should be immeasurably superior to the present badly grown deciduous crop ; in any case there is reasonable prospect that evergreen crops will be better adapted to this type of locality. No timber has been hitherto removed from the area.

236. The cost of establishing the crops, fire-protection, nursery, tools, pitting, sowing and planting, replacement of casualties in the first three years, cutting bamboos, etc., are as follows (actuals excluding overheads) :—

	RS.	A.	P.	Average per acre. RS.	A.	P.
Unit I (area 277 acres).						
Cost of formation (first year)	1,764	7	4	6	5	11
Cost of tending (1927–28)	294	6	3	1	1	0
Cost of tending (1928–29)	373	7	6	1	5	7
Cost of tending (1929–30)	215	6	0	0	12	5
Total up to 1930	2,647	11	1	9	8	11
Unit II (area 138·25 acres).						
Cost of formation (1927–28)	635	2	2	4	9	7
Cost of tending (1928–29)	136	3	9	0	15	9
Cost of tending (1929–30)	76	10	0	0	8	10
Total up to 1930	847	15	11	6	2	2

SECTION 3.—EXPERIMENTS.

237. The following details of experiments conducted within recent years by the district staff either independently or in co-operation with the Forest Research Officer are recorded hereunder. Information has been chiefly drawn from the District Experiment and Research register, and growth data of sample plots is given by the office of the Research Officer at Ootacamund.

A.—Experiments in the natural regeneration of Hopea.

238. Observations to see if isolated mature Hopea trees give more seed than those grown in close canopy.

Mr. Tireman noticed that trees growing in the open were flowering luxuriantly and was informed that they flowered annually in profusion. Ten trees were selected in 1922 for observation in Parappa, six in Nalkur, and six in Devachalla reserves. These were given full exposure of their crowns by removal of surrounding tree growth ; the majority were already however comparatively isolated. Results in 1923 were inconclusive and indicated no great improvement. Subsequently observations annually in the years 1924 to 1928 showed that these trees flowered only once in three or four years, but produced a fractional crop of seed (from one-fourth to one-half) generally two years in succession followed by two or more years without cropping. No very pronounced difference in habit from those in closer canopy could be deduced, but there is reason to presume that trees suddenly exposed would take a number of years to respond fully to such a change by enhanced crown development, and that those with fully developed crowns would naturally stock a fuller quantity of seed.

239. Observations on the number of seedlings under natural conditions which survive exposure to full sunlight after removal of overhead cover.

Ten patches of 5 yards square in Jalsur East reserve were selected. These were originally under dense cover, which was opened out when all trees in the top storey were felled or girdled in 1921. Three countings of seedlings were made in the following year 1922, one counting in 1923, two in 1924, and one in 1925. The first counting of all was probably not very reliable, many seedlings passing unobserved. Details are recorded in the District Research register. Many seedlings were slender and whip-like from suppression. The results of countings showed an immediate increase in the number of seedlings up to October 1922, followed by a slow but steady reduction subsequently from a total of 409 in October 1922 to 280 in October 1925. The inference is that sudden full exposure given to seedlings in natural forest did not kill any appreciable proportion of them but rather increased their number, and that in all probability subsequent prolific weed-growth and root competition rather than actual sunlight was responsible for a decline in numbers.

240. Investigation into the effect of weedings on natural regeneration of *Hopea parviflora* in a mixed forest containing seed-bearers of Hopea. (Forest Research Officer's experimental plots Nos. 13 and 14, Nalkur Reserved Forest.)

These two plots of ¼ acre each were opened in September 1920. In that year both plots were weeded and enumerated. Thereafter plot 13 was treated as a control and nothing was done to it ; plot 14 was weeded annually. An indicator patch 20 feet by

20 feet was laid out in each plot. In 1920, plot 13 had 3,662 seedlings and plot 14 had 2,709 seedlings. Seedlings in the indicator patches were counted in 1921 and in 1926. In the indicator patch of plot 13 (control) the number of seedlings in 1921 was 150 and in 1926, there were 106. In the patch of plot No. 14 (weeded annually) the number of seedlings rose from 214 in 1921 to 513 in 1926. The benefits attaching to weeding of the undergrowth seem obvious.

241. Observations made in order to determine the best degree of removal of cover and surrounding vegetation to suit natural Hopea regeneration in mixed semi-ever-green forest.

Five plots (Forest Research Officer experimental plots Nos. 6 to 10 in Nalkur Reserved Forest) were opened in 1921. The then existing Hopea regeneration was dense in each. The operations carried out were as follows :—

Plot 7 : control, nothing done.
,, 6 : weeds and undergrowth cut and removed.
,, 8 : weeds cut, upper storey cut or girdled.
,, 9 : undergrowth and middle storey cut and removed.
,, 10 : everything except Hopea cut and removed.

Enumerations were made in two indicator patches each 10 feet square in each plot, annually from 1921 to 1926. The number of seedlings enumerated varied considerably from year to year. The extreme case is given in plot 8, patch 11, wherein 684 seedlings were counted in 1921, 180 in 1924 and 445 in 1926. Similar fluctuations in numbers apparently appeared in all patches, but in every case the number of seedlings in 1926 was less than in 1921. The height increment of the largest seedlings varied more or less directly in proportion with the degree of light admitted. The following table (supplied by the Forest Research Officer) shows the average height increment of the six tallest seedlings in each patch from 1924 to 1926 :—

Plot.		Patch (i)		Patch (ii)		Combined increment of both patches.	
		FT.	IN.	FT.	IN.	FT.	IN.
7	Control	— 0	1	0	9	0	8
6	Weeds and undergrowth cut	0	7	0	7	1	2
9	Weeds, undergrowth and middle storey cut ..	0	10	1	7½	2	5½
8	Weeds and upper storey cut	2	6½	1	0	3	7½
10	Everything cut	3	6	2	9	6	3

These figures are undoubtedly remarkable, but useful comparison is vitiated considerably by the fact that in the last plot, wherein everything was removed but the Hopea, the average height of dominant seedlings was already 6 feet which was in advance of average conditions in the other plot, so that the crop might be considered as more established and capable normally of far greater height increment than younger growth.

The height increment of the crops *as a whole,* which is perhaps a safer criterion, gave a different result. The following table shows the increase in the number of seedlings over 3 feet high in each patch during 1925–26 :—

Plot.		Patch (i)	Patch (ii)	Total.
		INCHES.	INCHES.	INCHES.
7	Control	— 12	1	— 11
6	Weeds and undergrowth cut	— 3	1	— 2
0	Everything cut but Hopea	— 2	4	2
8	Weeds and upper storey cut	8	6	14
9	Weeds, undergrowth and middle storey cut ..	17	9	26

This shows that removal of undergrowth and middle storey, while retaining the top canopy, gave by far the best results. Unfortunately the standard of comparison was altered by different modes of recording results in different years, so that no sustained record is available. The apparent reduction of increment in plots 6, 7 and 10 is probably due to destruction of leading shoots by mechanical damage, climbers or by insect attack.

B.—Experiments in the artificial regeneration of Hopea.

242. To compare the results obtained (i) by pitting and sowing, (ii) by sowing in patches (not pitted), (iii) by burning and (iv) by not burning.

Two 2-acre plots in compartment 5 of Parappa reserve containing no Hopea seedlings were selected and in them all saleable timber was felled and removed. Unsaleable trees were left to provide shade. In one plot slash was burned, and in the other it was not burnt. Pits were dug 27 feet apart, in which Hopea seed was dibbled, over one acre in each plot. In the second area in each plot lines were cut 13½ feet apart and seeds were dibbled in the lines 13½ feet apart. Results after four hot weathers were recorded as follows :—

	Unburnt areas.	Burnt areas.
Pits dug	30 per cent survivals ..	50 per cent survivals.
Pits not dug	15 do. ..	16 do.

The average height of seedlings was about 16 inches. It is not recorded whether tending was carried out in this period, but probably not. The experiment achieved notably better success in burnt and pit-planted areas, although the efficacy of burning was not demonstrated completely.

243. To study the effect of complete removal of overhead shade on Hopea seedlings $4\frac{1}{2}$ years old which appeared well established, and to compare their height growth with that of seedlings of the same age growing under the shade of an overwood.

An area of two acres in compartment 7 of Parappa reserve with laterite clay soil, very little humus, and of gentle slope, very slightly northerly in aspect was selected in January 1925. Hopea had been sown in 1920 at an espacement of 12 feet by 12 feet. Twenty-four seedlings varying in height from $6\frac{1}{2}$ inches to $36\frac{1}{2}$ inches were staked and numbered. In an adjoining patch (not deprived of overhead canopy) 24 seedlings 37 inches to 110 inches in height were similarly selected. In the first plot seedlings were suddenly exposed by removing all overhead shade. Both areas were kept weeded. After 18 months, 38 per cent of seedlings in the exposed plot had died and all were heavily browsed by deer or cattle. The height increment was practically nil and many were set back. In the adjoining unfelled area there were no casualties, browsing was negligible and the height growth in the same interval varied from 11 inches to 28 inches, the average being about 15 inches.

244. One acre of Kaniyarmale reserve was selected in an almost blank grassy slope on poor laterite soil and was planted up with 660 seedlings, aged about two to three years in June 1921. After three years only 19 survived these being on an average about 32 inches in height.

245. Experiment in stump planting of Hopea and *Artocarpus hirsuta*. In accordance with the Chief Conservator's Proceedings No. 12, dated 10th March 1922, 75 seedlings each of Hopea and *Artocarpus* of heights ranging from 2 feet to 5 feet were collected, their roots and shoots were pruned and they were planted in nursery on the 10th April 1922 and watered. They were replanted in a sample plot on 12th June 1922. Six Hopea and six *Artocarpus* died in the nursery. The great majority sprouted and looked promising, but they died off in the following hot weather. By December 1924, 22 out of the 75 Hopea were surviving, and all the *Artocarpus* had died. A similar number were taken from the natural forest and the stumps planted direct into the sample plot. Again by 1924 all the *Artocarpus* stumps died, and of the Hopea 7 only survived. The conditions in the sample plot are not described.

246. A further experiment in stump-planting of Hopea was carried out in one acre of compartment No. 1 of Parappa reserve.

One thousand Hopea stumps were prepared from 4-year old seedlings and planted out two per patch. The stem was pruned to 2 inches above the collum, and the root to 6 inches length. Planting was done at the end of June 1926 when the monsoon was well started. Enumeration in August 1927 showed 71 per cent of successful patches, and 29 per cent of failures ; a subsequent enumeration in December 1927, however, showed only 15 per cent successful patches. The reason for this sudden decline after 13 months is not obvious. The shoots were described as lean and switchy, none being more than 1 foot in height. The root-system was devoid of a real tap-root, and weak. Again the condition of overhead shade cannot now be correctly ascertained, but it was probably rather heavy. The general conclusion is that stump-planting of Hopea is not advisable as it was nearly a total failure in the two experiments carried out.

C.—Regeneration with deciduous species.

247. An experiment was started in 1918 in Nerankimale reserve in order to ascertain the comparative effect of the clear-felling and improvement-felling system on the germination of seeds of useful deciduous timber species. The experiment involved both natural and artificial sowings. An area of 4 acres was divided into 1 acre plots, called A-1, A-2, B-3, B-4, respectively. A-1 and A-2 were clear-felled ; B-3 and B-4 were treated to fairly heavy improvement fellings so that about half the trees over 1 foot girth were removed. In A-2 and B-3, seeds of teak, *Xylia*, *Terminalias*, *Lagerstrœmia lanceolata* and *Pterocarpus Marsupium* were sown broad-cast. All four plots were then burnt. Sowing and burning operations were performed by the Vernacular Training School free of cost. The seedlings germinated quickly in A-2 and B-3 (both sown) plots. The whole area was again lightly reburnt in April 1920. In June 1920 regeneration of coppice-shoots and seedlings was found to be in the following order of success, viz., A-2, B-3, A-1, B-4 ; A-2 having almost twice the number of B-3 and three times the number of A-1. *Pterocarpus Marsupium* and *Lagerstrœmia lanceolata* were to be most successful species. The plots were weeded and interfering coppice growth was cut back in 1920.

Tending was continued at a cost of about Rs. 5 per annum up to 1928. Costs for each plot separately were not recorded.

A detailed enumeration after thorough weeding was made in June 1924. The results are recorded in the District Research and Experimental Journal.

This showed the largest numbers of seedlings and coppice-shoots in the clear-felled areas ; also the largest number of all in the clear-felled, unsown area (A-1) due to much greater incidence of *Xylia xylocarpa* seedlings and root-suckers. *Lagerstroemia lanceolata* and *Terminalia paniculata* were common to all four plots and fairly uniformly present throughout. The figures in all four plots showed a very large increase over the previous countings, due chiefly to the appearance of *Xylia xylocarpa* seedlings and root-suckers.

The total numbers recorded were :—A-1 (clear-felled, not sown) 1,681 seedlings and root-suckers and 92 coppice shoots ; A-2 (clear-felled, sown) 1,428 seedlings and root-suckers, 25 coppice shoots ; B-3 (residual canopy, sown) 923 seedlings, 11 coppice shoots ; B-4 (residual canopy, unsown) 546 seedlings, 14 coppice shoots.

248. It is evident that in mixed deciduous forests, especially those containing a fair proportion of *Xylia xylocarpa,* clear-felling combined with burning gives satisfactory results and in fuel coupes is superior to coppice with standards. Regeneration by root-suckers is considerable, and continues to appear spontaneously for several years after felling, this being particularly the case with *Xylia,* which does not immediately appear on the ground, but comes up later. It is to be remembered however, that tending was continued in this experiment for a longer period than is usual with fuel coupes, this being to a large extent essential for success.

Effect of Clear-felling on natural regeneration, with no subsequent attention.

249. A further experiment was carried out in Parappa compartment No. 3 in 1918-19. A plot of 2 acres was selected for clear-felling and was cut. Burning of the area was late and incomplete. In September 1919, the District Forest Officer remarked that coppice shoots were extraordinarily vigorous some 20 feet high. There were many teak seedlings, the highest being about 9 inches. No subsequent attention has been recorded, but countings were made at intervals the results being as follows :—

	Number of seedlings on		
	19th December 1919.	18th September 1920.	15th September 1921.
Teak	138	191	60
Lagerstroemia lanceolata	50	53	12
Terminalia tomentosa	36	19	18
Terminalia paniculata	7	26	22
Pterocarpus marsupium	9	4	..
Xylia xylocarpa	58	5	4

In 1921, the area was densely overgrown with vigorous coppice shoots of both useful and useless species. A "very heavy thinning" was necessary in order that seedlings might survive. It is possible that many seedlings were not observed, but the enumerations show rapid diminution in numbers consequent upon weed and coppice gaining predominance.

SECTION 4.—SPECIAL WORKS OF IMPROVEMENT UNDERTAKEN.

(*a*) *Improvements to navigability of rivers.*

250. *The Paiswani River.*—The work of clearing obstructions between Arlankai and Nayangayam, a distance of 7 miles, was started by the Public Works Department in 1920. The cost was Rs. 35,377. This resulted in our being able to raft large logs down stream from Parappa, and extended the possible floating season from three months to six months. Rafting charges were reduced from 5 annas per cubic foot to 3 annas per cubic foot. Minor obstacles above and below this stretch remained until 1926. The Public Works Department estimated the cost of removal at Rs. 11,000. Estimates were then prepared for clearing these departmentally, the rate adopted for blasting being Rs. 9–13–0 per 100 cubic feet (about an average between Local Fund Schedule 'Special' and 'Ordinary' rates). The work was executed in 1926 at a cost of about Rs. 3,000. The above works cannot be said to have repaid the department yet in savings on conveyance charges, or even to have repaid interest on the capital sum expended. Since heavy exploitation works at Parappa the total quantity of logs rafted to Kasaragod during the period 1921–1929 is 49,164 cubic feet at rates between As. 2–9 and 3 annas per cubic foot. The net savings to the department are Rs. 6,298. The quantities rafted have not been so much as they might otherwise have been owing to the installation of the Parappa Sawmill, which converted practically all the material felled between 1927 and 1929. A further saving of about Rs. 1,100 by rafting from Sampaje, the timber felled in 1928–29, was effected. It is unlikely that any further considerable quantities from Sampaje will be rafted to Kasaragod in the next ten years owing to dearth of bamboos consequent upon seeding. A sum of Rs. 50 was expended in 1928–29 in clearing the upper portions of the river from overhanging branches and bamboos.

251. *Improvements to other rivers.*—The question of improving the navigability of other large rivers in the district was investigated by the Public Works Department in 1922. In a letter No. 239-1, dated 11th August 1922, from the Superintending Engineer, IV Circle, Coimbatore, to the Chief Engineer for Irrigation, Madras, the following estimates for clearing obstructions in the rivers of Uppinangady taluk were given :—

	RS.
(1) Blasting rocks and clearing obstruction in Kallaje river (9 miles) ..	5,000
(2) Blasting rocks and clearing obstruction in Kumaradhari river (32 miles)	1,90,000
(3) Blasting rocks and clearing obstruction in Gundia river (16 miles).	33,000
(4) Blasting rocks and clearing obstruction in Netravati river (from Charmadi to Panemangalur)	3,55,000
(5) Blasting rocks and clearing obstruction in Shisla river (8 miles) ..	5.500

The amount of clearance adopted in the estimate is not stated.

Again in the following year 1923, further enquiry was pursued at the instigation of Mr. Tireman. The Netravati river between Vollal (37th mile on the Shiradi road) and Panemangalur was examined by the Public Works Department and an estimate for improving navigability was prepared. The estimated costs were as follows :—

	RS.
(1) Clearing obstacles from Panemangalur to Uppinangady	20,000
(2) Clearing obstacles from Uppinangady to Vollal	8,000
Total ..	28,000

Upon closer examination, it was found that the second item could be done for Rs. 5,000, and sanction for improving this small section alone was requested. Government however, declined to sanction any individual proposals in advance of general investigation and report by the Chief Forest Engineer, doubtless considering that such proposals should await examination concurrently with a larger scheme for exploitation of the forests. The Chief Forest Engineer, after inspecting some of the rivers in North Mangalore District only, stated that as a general rule the expense of improving rivers was too great for the benefits likely to accrue therefrom, and that it was preferable to have regular monthly deliveries of timber by cart or mechanical transport using the rivers only where easily floatable (Chief Conservator's L. Dis. No. 2624, dated 24th June 1926). The matter of general improvement to rivers was thereupon dropped.

252. A special scheme for the improvement of the Kumaradhari river from Uppinangady to Narimogar fuel coupes (4 miles), in order to facilitate the boating of fuel to Uppinangady was sanctioned, however. The work was done in 1924 departmentally at a cost of Rs. 752–6–0. Again, we have not fully availed ourselves of the advantage thus gained, as most of the Narimogar produce has gone to Puttur instead of Uppinangady.

(*b*) *Roads and Bridges.*

253. A table showing the principal roads and bridle-paths constructed is given, showing year and place of construction, and costs where ascertainable :—

	Description of roads.	Date of construction.	Length. M.	F.	Y.	Cost of construction. RS.	A.	P.
	Kasaragod Range.							
1	Muliar-Bavikere road (or Hirigeni-Bavikere road) ..	1910	3	4	0	1,259	0	0
2	Muliar-Hirigeni coupe road	1911–12	2	5	0	779	0	0
3	Muliar feeder road to coupe III	1917	0	2	0	50	0	0
4	Jalsur East, coupe road	1922	2	4	0	2,007	0	0
5	Parappa cart-track through coupe V	1922–23	0	2	91	57	0	0
6	Parappa compartments 8 and 9, extraction road ..	1926–27	2	0	0	1,510	0	0
7	Parappa compartment 10, extraction road	1928–29	0	7	0	735	0	0
8	Approach road to Parappa rest-house	1920	0	2	64	156	0	0
9	Murur-Kolchar road	1928–30	6	5	216	10,449	9	11
	Puttur Range.							
1	Kollamogaru bungalow approach road	1917	0	4	206	56	0	0
2	Kalanjimale feeder road	1920–21	0	2	21	107	0	0
3	Kalanjimale extraction road, coupe VII South ..	1922–23	1	4	107	299 (items 3 and 4)	0	0
4	Kalanjimale extraction road, coupe VII North ..	1922–23	1	0	5			
5	Kalanjimale extraction road, coupe VIII	1924–25	0	3	144	145	0	0
6	Nalkur exploitation road and its extensions in compartment 1.	1926–27 .. .. / 1928–30	3	5	3	4,507	0	0

	Description of roads.	Date of construction.	Length. M.	F.	Y.	Cost of construction. RS.	A.	P.
	UPPINANGADY RANGE.							
1	Hattiyadka road	1910	4	0	0	312	0	0
2	Vollal depot road	1906	0	3	0	34	0	0
3	Narimogar extraction road	1922–23	0	1	85	89	0	0
4	Narimogar feeder road, extension	1915–20	0	7	44	560	0	0
5	Narimogar extraction road	1923–24	0	2	157	175	0	0
6	Narimogar cart-track	1907	1	6	0	150	0	0
7	Approach road to Mannagundi rest-house	1925	0	0	100	3	8	0
8	Approach road to Sunkadakatte rest-house	1926	0	1	0	9	0	0
9	Nerankimale coupe road	1913	0	7	0	230	0	0
10	Nerankimale feeder road to coupes	1913	1	3	0	242	0	0
11	Shibaje cart-track	1914	0	5	160	370	0	0
12	Shibaje-Battadka depot road	1919–20	1	5	0	839	0	0

(c) *Buildings.*

254. The year and cost of construction of the forest buildings in the division are given in the subjoined statement :—

	Locality.	Particulars.	Date of construction.	Cost of buildings. RS.	A.	P.	Average approximate cost of repairs per annum. RS.	A.	P.
	HEADQUARTERS, MANGALORE.								
1	Mangalore, Kadri	District Forest Officer's bungalow; out-house consisting of four rooms for servants, garage, godown and carriage godown.	1928	18,904	9	0	50	0	0
2	Bunder	Depot, bungalow, out-house, latrine.	1905–06 and 1921.	6,059	0	0	200	0	0
3	Do.	Depot-keeper's quarters	1907	1,908	0	0	15	0	0
4	Do.	Watcher's quarters	1907	698	0	0	..		
5	Do.	Scantlings shed	1924	90	0	0	5	0	0
6	Do.	Do.	1926	178	0	0	..		
	KASARAGOD RANGE.								
1	Parappa	Rest-house, out-house, kitchen, servants' godowns, stable and motor garage.	1920	4,364	0	0	25	0	0
2	Do.	Ranger's rest-house	1924	1,659	0	0	10	0	0
3	Do.	Forester's quarters	1924	1,231	0	0	6	0	0
4	Do.	Forest guard's shed	1927	358	0	0	4	0	0
5	Kolchar	Rest-house with out-houses	1917	2,697	0	0	15	0	0
6	Adhur	Ranger's quarters with out-houses.	1915–16	1,451	0	0	..		
7	Do.	Range office	1915	729	0	0	..		
8	Do.	Subordinates' line	1922	2,031	0	0	..		
9	Muliar	Forest guard's shed	1906	122	0	0	4	0	0
10	Kandadka	Forester's quarters	1920	793	0	0	6	0	0
11	Do.	Motor shed	1923	44	0	0	4	0	0
12	Ajjanur	Forest guard's shed	1909	165	0	0	4	0	0
13	Jalsur	Thana shed house	1893	197	0	0	4	0	0
14	Goonadka	Elephant kraal	1926	889	0	0	..		
15	Do.	Shed for Range Officer	1926	59	0	0	..		
16	Do.	Shed for subordinates	1926	191	0	0	..		
17	Do.	Forest guard's shed	1928–29	611	0	0	4	0	0
	PUTTUR RANGE.								
1	Puttur	Range office and quarters with portico, kitchen, etc.	1890, 1902 and 1920.	1,715	0	0	20	0	0
2	Panja	Forest guard's shed	1906	125	0	0	..		
3	Do.	Forester's quarters	1921–22	954	0	0	4	0	0
4	Perbumpadi	Forest guard's shed	1906	125	0	0	6	0	0
5	Vittal	Do.	1908	312	0	0	4	0	0
6	Kollamogaru	Forester's quarters	1918	671	0	0	4	0	0
7	Do.	Double guard's shed	1919	952	0	0	8	0	0
8	Do.	Rest-house with out-houses	1918	3,181	0	0	15	0	0
9	Sullia	Forest guard's shed	1907	140	0	0	4	0	0
10	Baradka	Wooden rice granary	1928	340	0	0	5	0	0
11	Do.	Rest-house	1928–29	1,913	12	0	10	0	0
12	Do.	Forester's quarters and Forest guard's shed combined.	1922	140	0	0	8	0	0
13	Do.	Range inspection shed, kitchen	1924	67	0	0	..		
14	Polangayam	Temporary inspection shed	1925	204	0	0	..		

	Locality.	Particulars.	Date of construction.	Cost of buildings.			Average approximate cost of repairs per annum.		
				RS.	A.	P.	RS.	A.	P.
		UPPINANGADY RANGE.							
1	Bandihole, Beltangady.	Rest-house consisting of kitchen, servants' godowns and stables.	1917–18 ..	3,125	12	0	15	0	0
2	Uppinangady ..	Range office	1925 ..	2,257	0	0	15	0	0
3	Do. ..	Range quarters, out-house, kitchen.	1925 ..	3,590	0	0	15	0	0
4	Kombar	Rest-house, kitchen	1925 ..	1,371	0	0	5	0	0
5	Vollal	Depot-keeper's shed	1905–06 ..	269	0	0	..		
6	Mannagundi	Forest rest-house, kitchen and motor shed.	1924 and 1927.	2,091	0	0	..		
7	Do. ..	Forester's quarters	1925 ..	1,504	0	0	..		
8	Sunkadakatte ..	Rest-house	1927 ..	2,160	0	0	..		
9	Do. ..	Forester's quarters	1928–29 ..	1,328	6	0	10	0	0
10	Shiradi	Forest guard's quarters	1929 ..	1,067	0	0	..		
11	Vollal	Scantling shed	1926 ..	70	0	0	..		
12	Sunkadakatte ..	Double Forest guard's shed ..	1929–30 ..	123	0	0	5	0	0
13	Shiradi	Forest guard's quarters	(Taken from the Police Department.)				5	0	0

(*d*) *Wells.*

255. The following table gives a list of wells and cost of construction :—

Locality.	Building to which well is attached.	Date of construction.	Cost of wells.			Average approximate cost of repairs per annum.		
			RS.	A.	P.	RS.	A.	P.
	KASARAGOD RANGE.							
Parappa	Rest-house ; Forester's quarters.	1925 ..	298	0	0	5	0	0
Kolchar	Rest-house	1919 ..	416	0	0	5	0	0
Adhur	Range quarters	1916 ..	435	0	0	5	0	0
Kandadka	Forest guard's quarters	1920 ..	286	0	0	5	0	0
Ajjanur	Forest guard's shed	1909 ..	32	0	0	5	0	0
	PUTTUR RANGE.							
Puttur	Range quarters	1890 ..	250	0	0	5	0	0
Panja	Forester's quarters	1924 ..	396	0	0	5	0	0
Vittal	Forest guard's shed	1912 ..	24	0	0	5	0	0
Sullia	Do.	1907 ..	23	0	0	5	0	0
Kollamogaru	Rest-house	1918 ..	259	0	0	5	0	0
Baradka	Do.	1926 ..	390	0	0	5	0	0
Goonadka	Forest guard's shed	1930 ..	58	0	0	5	0	0
	UPPINANGADY RANGE.							
Mannagundi	Rest-house	1926 ..	521	0	0	5	0	0
Sunkadakatte	Do.	1928 ..	519	0	0	5	0	0
Shiradi	Forest guard's shed	..	..			5	0	0
Kadri	District Forest Officer's bungalow.	1928 ..	1,228	12	0	..		
Bunder	Bunder depot	..	..			..		

SECTION 5.—PAST YIELDS.

256. The following tables give a summary of past yields from the division, so far as has been ascertained from records :—

Past outturn of timber from reserves worked during the period 1919–20 *to* 1929–30.

Name of reserve.	Timber—All marketable species.											Total.
	1919–20.	1920–21.	1921–22.	1922–23.	1923–24.	1924–25.	1925–26.	1926–27.	1927–28.	1928–29.	1929–30.	
	C. FT.	C. FT.	C. FT.	C. FT.	C. FT.	C. FT.	C. FT.	C. FT.	C. FT.	C. FT.	C. FT.	C. FT.
UPPINANGADY RANGE.												
1 Porkala	4,622·00	..	4,384·30	..	..	..	..	9,125·00	16,230·00	25,415·00	11,468·00	71,244·30
2 Bhagimale	3,867·00	..	..	..	..	..	..	..	..	..	..	3,867·00
3 Padnur	..	..	..	1,515·00	15,245·00	11,167·00	6,093·00	5,500·00	..	..	..	39,520·00
4 Mujur	..	..	..	..	..	..	..	..	..	..	27,637·00	27,637·00
PUTTUR RANGE.												
1 Nalkur	..	..	..	..	..	..	4,988·00	28,300·00	22,37[illegible]·00	11,500·00	27,767·00	94,929·00
2 Jalsur East	23,571·00	9,297·43	..	..	3,012·58	4,128·00	..	..	..	..	..	40,009·01
KASARGOD RANGE.												
1 Sampaje	..	..	..	..	..	..	..	..	..	16,771·00	13,231·00	30,002·00
2 Todikan	..	..	..	500·00	..	..	..	..	..	..	..	500·00
3 Parappa	9,909·96	11,029·71	..	33,614·00	15,505·00	20,170·00	25,512·00	47,000·00	87,189·00	88,203·00	52,539·00	390,671·67
4 Mundakole	..	..	..	..	..	..	..	..	..	..	22,705·00	22,705·00
5 Aletti West	..	..	..	..	..	..	..	..	..	45,858·00	20,637·00	66,495·00
RIVER MARGINS.												
Paiswani and Karadka stream margins	4,726·56	8,327·50	..	..	5,032·00	3,610·00	..	..	..	..	..	21,696·06
Total ..	46,696·52	28,654·64	4,384·30	35,629·00	38,794·58	39,075·00	36,593·00	89,925·00	125,793·00	187,747·00	175,984·00	809,275·74

Past yields—Fuel Working Circle—Nerankimale Series—Uppinangady Range.

Year of working.	Coupe number.	Area of coupe. ACS.	Area worked.	Fuel chowks. C. FT.	Timber. C. FT.	Bamboos.	System of working.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1911–12	I	48·80	48·80	35·00	..	..	
1912–13	II	18·44	18·44	50·00	..	..	
1913–14	III	21·90	21 90	50·00	..	..	
1914–15	IV	41·20	41·20	50·00	..	..	Coppice with standards.
1915–16	..	..	..	..	..	..	
1916–17	V	52·20	52·20	416 00	..	..	
1917–18	VI	39·20	39·20	207·75	2,272·16	..	
1918–19	VII	20·20	20·20	212·94	1,147 13	..	
1919–20	VIII	20·80	20 80	122·88	2,339·16	..	
1920–21	IX	31·40	31·40	170·25	1,476·17	..	Thinnings.
1921–22	X	24·40	24·40	200·00	912·68	..	
1922–23	XI	30·80	30·80	517·63	5,269·40	..	
1923–24	XII	42·40	42·40	690·75	8,020·28	..	Simple coppice.
1924–25	XIII	36 50	36·50	705·00	4,167·34	..	
1925–26	XIV	17·00	17·00	235·00	1,800·75	..	
1926–27	XIV	2·50	2·50	72·00	200 00	..	
	XV	15 30	15·30	244·00	1,530·00	..	
1927–28	XV	6·50	6·50	114·00	2,600·00	..	Simple coppice.
	XVI	16·92	16·92	250 00	3,200·00	..	
1928–29	XVII	21·00	21·00	250 00	9,200·00	..	
1929–30	XVIII	23·00	23·00	251·00	2,750·00	..	
1930–31	XIX	..	..	..	..	..	

Past yields—Fuel Working Circle—Narimogar Series—Puttur Range.

Year of working.	Coupe number.	Area of coupe. ACS.	Area worked.	Fuel chowks. C. FT.	Timber. C. FT.	Bamboos.	System of working.
1906–07	I	2·00	2·00	14·25	..	8	
1907–08	V	1·00	1·00	14·75	278·00	..	
1908–09	I	20·00	20·00	131·00	..	..	
1909–10 *	..	..	..	..	..	..	
1910–11	I	6·00	6·00	27·50	..	58	
1911–12	I	7·00	7·00	94·50	..	..	
1912–13	I	4·00	4·00	32·00	..	..	Coppice with standards.
1913–14	I	7·20	7·20	55·00	..	..	
1914–15	I	10·40	10·40	69 00	27·22	..	
1915–16	II	2·50	2·50	23·00	..	600	
1916–17 †	..	..	..	..	..	..	
1917–18	III	10·00	10·00	138·00	645·00	..	
1918–19	IV	10·60	10·60	50·00	..	..	
1919–20	IV	10·00	10 00	75·00	..	..	
1920–21	IV	5·20	5·20	6·50	1,027·00	..	
	V	1·30	1·30	68·00	..	..	
1921–22	V	6·00	6·00	64·00	256·00	..	
	VI	10·40	10·40	161·00	..	..	
1922–23	VIII	10·00	10·00	108 00	657·00	..	
1923–24	VIII	13·14	13·14	286·00	450·00	..	
1924–25	IX	30 40	30·40	663·00	985 00	..	Simple coppice.
1925–26	X	30·40	30·40	50·00	1,906·00	..	
1926–27	XI	37·20	20·20	320·00	1,550·00	..	
1927–28	XII	31·50	27·50	228·00	1,850·00	..	
1928–29	XI	17·00	17·00	125·00	..	..	
	XII	4·00	4·00	..	90·00	..	
1929–30	XIII	18·00	18·00	343·00	900·00	..	
1930–31	XIV	16·00	16·00	175 00	1,000·00	..	

* Not worked.

† Further working of this Circle was stopped owing to inadequate demand,—vide B.P. Mis. No. 89, dated 12th March 1917.

SECTION 6.—PAST REVENUE AND EXPENDITURE.

257. Statements of past revenue and expenditure for the division are appended :—

Statement of Past Revenue for South Mangalore Division—Rangewar.

Year.	Timber.	Fuel.	Bamboo.	Grazing.	Minor forest produce.	Sandal.	Miscellaneous.	Total.
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
				PUTTUR RANGE.				
1916–17 ..	1,423 10 1	1,358 14 3	204 10 5	1,512 12 0	3,688 10 4	11 3 0	3,558 11 9	11,758 7 10
1917–18 ..	2,148 5 2	265 4 6	17 7 0	1,518 15 0	2,627 1 8	..	2,936 4 7	9,513 5 11
1918–19 ..	2,637 14 0	6,728 13 11	64 1 7	1,395 15 0	10,592 9 4	..	2,819 6 2	24,238 12 0
1919–20 ..	1,064 12 9	3,907 0 5	93 12 0	1,452 12 0	8,332 6 3	..	2,803 15 2	17,654 10 7
1920–21 ..	1,255 2 3	3,453 10 11	51 4 0	2,160 4 0	1,804 2 0	1,281 12 2	2,219 13 10	12,226 1 2
1921–22 ..	1,484 14 7	1,753 6 11	65 1 8	1,296 10 0	1,835 15 7	958 0 0	2,219 7 2	9,613 7 11
1922–23 ..	3,856 9 9	7,188 7 5	154 15 5	1,863 6 0	2,988 11 4	875 1 1	3,442 5 10	20,369 8 10
1923–24 ..	4,132 8 11	2,986 3 0	27 8 0	2,159 14 0	3,406 12 3	13 1 0	2,912 13 7	15,638 12 9
1924–25 ..	3,564 14 4	1,294 5 1	268 9 9	2,270 8 0	3,665 10 6	107 13 0	3,336 14 0	14,508 10 8
1925–26 ..	17,104 6 2	1,633 1 8	401 1 0	2,707 12 0	3,471 2 11	99 3 0	3,404 13 4	28,821 8 1
1926–27 ..	9,107 10 10	347 3 10	52 9 0	2,771 0 0	2,008 3 6	481 9 2	4,798 13 7	19,567 1 11
1927–28 ..	17,711 13 11	216 9 6	166 0 0	2,843 10 0	2,435 8 1	650 4 6	5,042 7 9	29,072 5 9
1928–29 ..	4,347 10 7	270 2 5	123 4 0	2,925 14 0	6,089 14 9	438 0 0	3,848 1 1	18,042 14 10
1929–30 ..	5,013 14 0	198 3 10	430 12 0	3,026 8 0	2,556 4 5	..	4,863 6 1	16,089 0 4
Total ..	**74,854 3 4**	**31,601 7 8**	**2,120 15 10**	**29,911 12 0**	**55,503 0 11**	**4,915 14 11**	**48,207 5 11**	**2,47,114 12 7**
				KASARAGOD RANGE.				
1916–17 ..	11,776 10 2	3,514 6 3	481 9 6	1,196 4 0	584 4 11	11 3 3	6,835 5 0	24,399 11 1
1917–18 ..	10,411 0 11	1,828 14 4	541 13 10	1,135 11 0	1,213 9 5	..	6,775 11 7	21,906 13 1
1918–19 ..	17,422 6 6	3,040 11 3	572 5 0	1,164 3 0	24,058 9 7	1,833 0 9	10,528 11 3	58,619 15 4
1919–20 ..	35,553 7 2	1,593 13 1	408 7 0	1,222 11 0	6,416 5 8	51 8 4	6,053 15 2	51,300 3 5
1920–21 ..	33,821 5 2	978 10 6	304 15 3	2,263 2 0	2,805 8 8	1,281 12 2	4,586 1 4	46,041 7 1
1921–22 ..	14,956 10 11	920 5 7	288 1 0	1,973 0 0	3,153 0 6	958 0 0	4,609 6 7	26,858 8 7
1922–23 ..	51,026 5 6	1,686 11 11	201 8 0	1,904 2 0	1,061 4 2	916 1 2	6,743 2 9	63,539 3 6
1923–24 ..	30,640 10 0	1,680 0 11	143 12 6	2,069 4 0	550 13 3	3,898 8 7	7,286 9 1	46,269 10 4
1924–25 ..	61,887 15 4	3,066 8 11	359 12 0	2,126 0 0	1,645 7 2	272 8 0	5,027 7 3	74,385 10 8
1925–26 ..	29,435 0 6	2,328 12 4	344 13 10	1,653 0 0	304 4 2	1,166 4 3	8,031 0 1	43,263 3 2
1926–27 ..	28,453 14 10	1,504 10 9	..	1,599 6 0	241 11 6	2,586 7 2	4,175 10 3	38,561 12 6
1927–28 ..	10,190 0 5	1,895 3 3	300 0 0	1,571 2 0	310 1 6	1,643 1 2	2,984 14 5	18,894 6 9
1928–29 ..	21,853 10 9	1,577 6 4	210 8 0	1,677 2 0	1,124 15 0	2,740 8 1	5,525 0 10	34,709 3 0
1929–30 ..	7,703 15 3	2,509 4 9	86 7 7	1,655 4 0	250 1 6	..	3,681 15 6	15,887 0 7
Total ..	**3,65,133 1 5**	**28,125 8 2**	**4,244 1 6**	**23,210 3 0**	**43,720 1 0**	**17,358 14 11**	**82,844 15 1**	**5,64,636 13 1**

Statement of past revenue for South Mangalore Division—Rangewar—cont.

Year.	Timber.	Fuel.	Bamboo.	Grazing.	Minor forest produce.	Sandal.	Miscellaneous.	Total.
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
				UPPINANGADY RANGE.				
1916–17 ..	1,339 3 3	554 12 5	434 4 6	4,774 5 0	4,229 12 6	11 3 0	1,654 3 11	12,997 12 7
1917–18 ..	5,466 6 1	6,492 0 2	1,187 11 8	4,843 14 0	2,317 2 5	..	2,120 10 5	22,427 12 9
1918–19 ..	7,043 5 11	3,238 9 4	1,249 4 2	3,341 14 0	11,792 4 10	..	2,590 1 7	29,255 7 10
1919–20 ..	3,112 4 6	5,950 8 5	1,174 3 11	4,115 13 0	8,378 8 5	..	1,362 5 2	24,093 11 5
1920–21 ..	4,679 11 4	4,034 0 11	1,160 5 3	3,597 12 0	2,266 10 7	1,281 12 2	734 9 8	17,754 13 11
1921–22 ..	9,290 5 10	5,322 1 8	1,950 15 2	3,224 12 0	2,252 1 1	957 15 11	1,260 8 1	24,258 11 9
1922–23 ..	15,779 4 4	4,233 8 7	1,779 7 0	6,432 0 0	2,688 12 7	875 1 1	1,187 2 1	32,975 3 8
1923–24 ..	15,324 9 3	3,810 12 7	236 12 0	6,249 6 0	2,623 3 11	13 1 0	924 8 9	29,182 5 6
1924–25 ..	15,157 2 5	7,196 0 11	614 13 0	4,895 6 0	1,339 10 8	1,127 3 0	1,989 2 3	32,319 6 3
1925–26 ..	12,512 6 9	705 15 1	626 1 8	2,012 4 0	1,241 11 10	1,499 8 1	1,159 7 0	19,757 6 5
1926–27 ..	27,488 12 7	2,502 0 2	0 8 0	1,769 8 0	1,732 5 8	436 8 8	1,158 10 9	35,088 5 10
1927–28 ..	19,232 10 2	1,325 7 3	18 8 0	3,176 14 0	3,673 13 4	750 6 10	1,951 14 9	30,129 10 4
1928–29 ..	16,328 6 10	512 7 0	..	3,735 14 0	2,547 12 0	314 0 0	1,141 7 1	24,579 14 11
1929–30 ..	739 12 2	820 3 0	8 4 0	3,568 0 0	2,100 11 4	..	..	7,236 14 6
Total ..	**1,53,494 5 5**	**46,698 7 6**	**10,441 2 4**	**55,737 10 0**	**49,184 9 2**	**7,266 11 9**	**19,234 11 6**	**3,42,057 9 8**
				BELTANGADY RANGE.*				
1924–25 ..	127 10 0	3 4 0	..	..	8 5 0	..	130 7 0	269 10 0
1925–26 ..	807 7 4	158 4 4	4 8 0	1,051 2 0	645 6 0	..	883 3 1	3,549 14 9
1926–27 ..	901 2 2	122 12 9	12 0 0	1,325 4 0	326 11 4	..	1,436 10 2	4,124 8 5
1927–28 ..	334 11 6	21 5 6	30 0 0	1,457 6 0	487 3 0	..	1,043 3 0	3,373 13 0
1928–29 ..	408 3 4	14 6 4	36 12 0	1,523 14 0	950 4 2	..	857 7 5	3,790 15 3
1929–30 ..	609 13 10	13 9 1	29 0 0	1,535 0 0	375 3 8	..	1,213 1 8	3,775 12 3
Total ..	**3,189 0 2**	**333 10 0**	**112 4 0**	**6,892 10 0**	**2,793 1 2**	..	**5,564 0 4**	**18,884 9 8**

* Formed only during 1924–25.

Statement of past revenue for South Mangalore Division.

Year.	Timber.	Fuel.	Bamboo.	Grazing.	Minor forest produce.	Sandal.	Miscellaneous.	Total.
1916–17 ..	14,539 7 6	5,428 0 11	1,120 8 5	7,483 5 0	8,502 11 9	33 9 3	12,048 4 8	49,155 15 2
1917–18 ..	18,025 12 2	8,586 3 0	1,747 0 6	7,498 8 0	6,157 13 6	..	11,832 10 7	53,847 15 5
1918–19 ..	27,103 10 5	13,008 2 6	1·885 10 9	5,902 0 0	46,443 7 9	1,833 0 9	15,938 3 0	1,12,114 3 2
1919–20 ..	39,730 8 5	11,451 5 11	1,676 6 11	6,791 4 0	23,127 4 4	51 8 4	10,220 3 6	93,048 9 3
1920–21 ..	39,756 2 9	8,466 6 4	1,516 8 6	8,021 2 0	6,876 5 3	3,845 4 6	7,540 8 10	76,022 6 0
1921–22 ..	25,731 15 4	7,995 14 2	2,304 1 10	6,494 6 0	7,241 1 2	2,873 15 11	8,089 5 10	60,730 12 7
1922–23 ..	70,662 3 7	13,108 11 11	2,135 14 5	10,199 8 0	6,738 12 1	2,666 3 4	11,372 10 8	1,16,884 0 7
1923–24 ..	50,097 12 2	8,477 0 6	408 0 6	10,478 8 0	6,580 13 5	3,924 10 7	11,123 15 5	91,090 12 5
1924–25 ..	80,737 10 1	11,560 2 11	1,243 2 9	9,291 14 0	6,659 1 4	1,507 8 0	10,483 14 6	1,21,483 5 8
1925–26 ..	59,859 4 9	4,826 1 5	1,376 8 6	7,424 2 0	5,936 0 0	2,764 15 4	13,478 7 6	95,392 0 0
1926–27 ..	65,951 8 5	4,476 11 6	65 1 0	7,465 2 0	4,309 0 0	3,504 9 0	11,569 12 9	97,341 12 5
1927–28 ..	47,469 4 0	3,458 9 6	514 8 0	9,055 0 0	6,906 9 11	3,043 12 6	11,022 7 11	81,470 3 10
1928–29 ..	1,23,558 0 0	2,374 6 1	370 8 0	9,862 12 0	10,712 13 11	3,753 0 0	11,372 0 5	1,62,003 8 5
1929–30 ..	40,438 0 0	3,530 0 0	566 0 0	9,784 12 0	10,022 0 0	9,941 0 0	9,027 0 0	83,308 12 0
Total ..	**7,03,661 3 7**	**1,06,747 12 8**	**16,930 0 1**	**1,15,752 3 0**	**1,56,213 14 5**	**39,743 1 6**	**1,55,119 9 7**	**12,94,167 12 10**
Aaverage per annum.	**50,200 0 0**	**7,600 0 0**	**1,200 0 0**	**8,300 0 0**	**11,200 0 0**	**2,800 0 0**	**1,100 0 0**	**92,500 0 0**

Summary of Past Expenditure—Rangewar.

Year.	Cost of conservancy and exploitation.				Cost of works.				Land acquisition.	Miscellaneous.	Cost of establishment.		Total.
	Timber extraction.	Regeneration.	Fire protection.	Live-stock.	Roads and bridges.	Buildings.	Wells and other works.	Demarcation.			Pay and allowances.	Contingencies.	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	RS. A. P.	RS A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.
						PUTTUR RANGE.							
1916–17 ..	12 4 0	21 2 0	775 2 0	4 8 0	55 8 0	865 0 0	5 0 0	19 11 0	..	1,526 14 2	7,009 11 9	925 3 1	11,220 0 0
1917–18 ..	..	..	772 0 2	981 2 3	162 14 0	1,198 3 1	302 2 7	8 2 0	4 10 8	3,573 14 8	6,492 12 2	918 5 10	14,414 3 5
1918–19 ..	821 2 6	..	789 8 2	7,931 9 0	68 7 0	313 11 3	..	..	..	10,404 0 7	10,533 13 5	2,064 0 4	32,926 4 3
1919–20 ..	130 0 2	24 9 6	766 12 6	5,740 8 6	1,226 3 3	1,919 13 10	2 0 0	15 9 6	..	7,919 14 4	8,940 14 9	1,891 9 8	28,578 0 0
1920–21 ..	159 15 7	19 10 0	350 7 10	885 6 0	404 5 0	395 7 2	0 13 0	42 8 0	..	2,656 4 0	9,181 5 10	431 14 0	14,528 0 5
1921–22 ..	470 12 0	587 6 11	883 8 7	5 4 0	360 6 6	344 4 9	4 6 0	..	..	3,373 9 0	13,917 13 8	933 3 3	20,880 10 8
1922–23 ..	385 6 0	319 13 6	884 4 6	24 3 9	618 14 3	158 11 6	0 12 0	6 0 0	..	3,482 0 8	17,378 1 6	550 15 11	23,813 3 7
1923–24 ..	230 4 0	0 3 0	573 13 0	..	300 10 0	466 3 1	652 15 6	2 0 0	..	2,503 12 11	18,396 14 0	520 6 7	23,647 2 1
1924–25 ..	481 1 5	65 0 0	675 9 6	765 3 1	710 3 6	562 9 6	449 10 7	136 5 8	..	1,803 3 3	20,522 0 0	746 5 0	26,917 3 6
1925–26 ..	5,734 11 6	..	793 8 0	3,216 6 4	433 1 6	766 7 8	391 15 0	..	..	1,323 14 3	34,039 14 10	836 6 9	47,536 5 10
1926–27 ..	12,687 3 0	14 6 0	816 11 6	1,876 10 6	2,196 9 0	362 8 0	20 10 0	448 3 6	450 0 0	1,945 5 5	15,557 13 4	689 14 7	37,065 14 10
1927–28 ..	11,430 2 6	172 4 0	786 14 0	1,349 4 6	2,115 11 0	429 14 9	17 15 6	..	..	1,012 6 0	13,372 15 9	793 10 0	31,481 2 0
1928–29 ..	20,008 14 9	50 5 0	735 1 0	2,641 7 1	890 6 0	2,592 1 3	22 0 0	15 12 0	..	984 7 3	16,693 3 0	948 11 6	45,582 4 10
1929–30 ..	14,040 5 1	647 14 0	718 15 0	1,732 4 6	496 0 0	806 4 3	68 2 0	..	..	1,922 1 3	8,661 12 0	69 3 0	29,162 13 1
Total ..	**66,592 2 6**	**1,922 9 11**	**10,326 3 9**	**27,153 13 6**	**10,039 3 0**	**11,181 4 1**	**1,938 6 2**	**694 3 8**	**454 10 8**	**44,431 11 9**	**2,00,699 2 0**	**12,319 13 6**	**3,87,753 4 6**
						KASARAGOD RANGE.							
1916–17 ..	184 6 0	16 3 6	751 7 2	1,682 7 5	121 1 6	859 9 0	448 6 2	24 8 0	..	1,351 13 0	8,430 9 3	909 7 7	14,779 14 7
1917–18 ..	1,155 15 7	29 0 0	706 15 2	1,512 10 9	128 1 0	90 6 6	..	17 0 0	..	20,105 7 0	8,908 0 4	1,007 14 6	33,661 6 10
1918–19 ..	7,712 10 6	17 10 0	771 3 0	2,562 11 0	1,429 9 10	3,862 15 2	297 3 0	681 3 6	..	3,970 8 0	11,253 13 8	2,180 10 2	34,740 1 10
1919–20 ..	14,421 15 4	1,114 9 9	876 0 11	3,669 6 11	1,294 12 4	3,644 12 7	581 9 0	9 0 0	..	8,433 11 10	10,949 13 4	2.134 14 11	47,130 10 11
1920–21 ..	9,381 4 3	1,393 10 3	492 2 7	4,884 7 6	480 4 9	547 0 9	98 13 0	30 11 6	..	1,081 12 5	13,517 13 10	1,415 13 3	33,323 14 6
1921–22 ..	18,410 6 8	4,229 7 9	1,425 7 1	5,701 13 11	215 8 6	585 4 10	134 0 0	..	..	1,925 1 4	20,282 11 2	913 3 1	53,823 0 4
1922–23 ..	22,392 13 4	3,286 6 2	1,193 5 6	5,071 6 10	189 14 0	400 13 3	25 2 8	11 2 0	29 10 0	1,405 5 4	22,571 10 5	793 3 10	57,370 13 4
1923–24 ..	11,654 2 5	2,500 11 2	881 3 10	2,193 1 7	258 6 9	2,907 0 11	297 8 0	..	..	913 1 8	20,765 2 9	539 15 4	42,910 6 5
1924–25 ..	11,654 2 5	1,296 10 0	672 11 6	1,934 5 4	151 10 6	217 12 7	21 3 0	29 5 4	..	826 2 2	19,865 6 6	711 1 8	37,380 7 0
1925–26 ..	11,872 2 2	1,316 9 3	548 2 6	2,881 4 0	329 1 0	1,165 8 6	417 6 6	2,839 11 0	..	1,017 6 7	14,442 15 0	735 9 7	37,565 12 1
1926–27 ..	13,362 13 9	1,998 2 0	574 2 4	4,864 4 11	1,755 11 9	918 5 7	2,947 5 0	411 8 6	450 0 0	1,393 2 1	21,108 7 5	1,287 10 1	51,071 9 5
1927–28 ..	13,744 11 4	2,079 13 3	466 8 0	8,507 4 4	5,272 13 6	4,621 4 8	41 8 0	1,438 1 6	..	1,534 12 1	25,247 0 0	1,761 8 0	64,714 4 8
1928–29 ..	12,841 9 3	516 9 0	506 10 0	8,752 14 9	5,371 13 6	360 7 3	39 0 0	226 8 0	..	1,834 9 1	26,536 9 0	1,655 8 0	58,642 7 10
1929–30 ..	25,173 11 0	1,616 3 0	514 8 6	9,746 0 10	1,376 13 4	1,738 9 9	28 1 0	106 12 0	..	3,952 3 3	12,741 6 0	219 3 0	57,213 7 8
Total ..	**1,73,962 12 0**	**21,411 9 1**	**10,380 8 0**	**63,964 4 1**	**18,375 0 3**	**21,919 15 4**	**5,377 1 4**	**5,825 7 4**	**479 10 0**	**49,744 15 10**	**2,36,621 6 8**	**16,265 11 5**	**6,24,328 5 5**
						UPPINANGADY RANGE.							
1916–17 ..	443 11 11	3 12 0	1,833 7 8	1,354 8 6	4 0 0	1,356 3 0	..	46 12 0	..	2,559 9 8	6,951 5 2	977 3 10	15,530 9 9
1917–18 ..	453 10 0	..	1,230 15 0	1,170 14 11	41 0 0	1,100 5 0	23 3 7	..	..	5,058 10 2	7,279 4 1	984 3 0	17,342 1 9
1918–19 ..	1,096 7 11	13 12 0	1,315 3 5	845 3 6	455 0 0	150 0 8	..	..	..	12,474 15 9	9,916 13 6	2,083 0 11	28,350 9 8
1919–20 ..	1,745 6 6	483 3 6	699 5 10	2,412 0 4	1,033 15 4	127 2 2	30 8 0	..	..	11,374 13 4	8,540 7 3	1,911 7 9	28,358 6 0
1920–21 ..	2,509 10 4	1,146 13 0	369 2 0	3,100 13 9	288 12 9	114 9 6	25 4 0	41 8 0	..	2,851 9 0	9,615 1 5	481 13 10	20,545 1 7
1921–22 ..	3,183 8 10	557 14 0	1,544 12 7	569 11 6	30 0 0	209 9 9	157 7 5	..	..	2,119 13 0	15,275 7 4	886 8 4	24,534 12 0
1922–23 ..	1,473 13 8	3,208 5 4	1,138 14 7	809 6 10	244 7 0	1,018 4 8	382 6 6	..	..	3620 8 0	18,987 14 3	562 3 7	31,446 4 5
1923–24 ..	4,860 5 9	2,616 8 9	891 11 4	1,525 7 10	199 3 0	1,718 15 0	25 14 0	..	..	1,880 8 1	19,543 10 4	564 15 1	33,827 3 2
1924–25 ..	6,324 5 2	2,536 6 0	735 2 0	1,153 4 6	366 3 0	6,339 8 0	23 0 0	..	..	1,680 10 0	16,796 9 6	300 0 8	36,255 0 10
1925–26 ..	8,116 11 10	1,861 8 0	671 7 0	712 15 5	46 8 0	2,359 10 0	220 0 0	..	..	1,107 11 2	11,338 12 0	530 14 9	26,966 2 2
1926–27 ..	5,778 3 6	1,567 1 6	612 12 0	717 3 9	29 10 0	1,847 1 2	317 13 0	426 14 3	450 0 0	752 5 9	15,987 8 5	658 5 1	29,144 14 5
1927–28 ..	8,328 4 0	1,425 13 0	475 2 0	1,008 10 5	201 12 0	320 11 7	227 15 0	29 0 0	..	828 15 0	12,074 10 0	602 7 0	25,523 4 0
1928–29 ..	12,468 2 6	262 1 0	546 14 0	1,496 2 2	77 10 0	1,484 0 6	327 11 0	16 0 0	..	425 9 3	13,643 12 0	574 0 0	31,321 14 5
1929–30 ..	12,932 1 9	370 2 0	351 2 0	1,367 7 6	106 9 0	573 4 3	5 3 0	15 4 0	..	480 11 3	6,577 3 0	34 2 0	22,813 1 9
Total ..	**69,714 7 8**	**16,053 4 1**	**12,415 15 5**	**18,243 14 11**	**3,124 10 1**	**18,719 4 6**	**1,766 5 6**	**575 6 3**	**450 0 0**	**47,216 5 5**	**1,72,528 6 3**	**11,151 5 10**	**3,71,959 5 11**

Summary of Past Expenditure—Rangewar—cont.

Year (1)	Cost of conservancy and exploitation. Extraction timber. (2) RS. A. P.	Regeneration. (3) RS. A. P.	Fire protection. (4) RS. A. P.	Livestock. (5) RS. A. P.	Cost of works. Roads and bridges. (6) RS. A. P.	Buildings (7) RS. A. P.	Wells and other works. (8) RS. A. P.	Demarcation. (9) RS. A. P.	Land acquisition. (10) RS. A. P.	Miscellaneous (11) RS. A. P.	Cost of establishment. Pay and allowances. (12) RS. A. P.	Contingencies. (13) RS. A. P.	Total (14) RS. A. P.
					BELTANGADY RANGE.								
1924–25 ..	..	..	270 0 0	..	..	..	..	..	..	67 12 0	6,653 [illegible]	56 11 9	7,048 3 3
1925–26 ..	2 0 0	8 9 0	290 9 0	..	..	10 15 6	..	7 11 0	..	29 10 0	6,26[illegible]	443 9 4	7,057 14 8
1926–27 ..	5 2 0	1,742 5 6	280 8 0	..	..	54 0 0	..	17 0 0	450 0 0	377 14 4	11,19[illegible]	612 13 7	14,738 11 9
1927–28 ..	..	852 8 0	237 0 0	..	..	14 4 0	..	7 8 0	..	333 0 2	5,12[illegible]	82 8 0	6,649 1 2
1928–29 ..	..	413 7 3	273 8 0	..	..	161 12 3	..	1 8 0	..	119 0 3	4,5[illegible]	91 3 9	5,641 10 9
1929–30 ..	13 12 0	212 8 6	130 0 0	..	..	74 11 9	..	4 9 0	..	142 14 9	4,62[illegible]	50 11 9	5,253 11 9
Total ..	**20 14 0**	**3,229 6 3**	**1,481 9 0**	..	..	**315 11 6**	..	**38 4 0**	**450 0 0**	**1,070 3 6**	**38,445 10 8**	**1,337 10 2**	**46,389 5 1**

Summary of past expenditure in South Mangalore Division.

Year (1)	Extraction timber. (2) RS. A. P.	Regeneration. (3) RS. A. P.	Fire protection. (4) RS. A. P.	Livestock. (5) RS. A. P.	Roads and bridges. (6) RS. A. P.	Buildings (7) RS. A. P.	Wells and other works. (8) RS. A. P.	Demarcation. (9) RS. A. P.	Land acquisition. (10) RS. A. P.	Miscellaneous (11) RS. A. P.	Pay and allowances. (12) RS. A. P.	Contingencies. (13) RS. A. P.	Total (14) RS. A. P.
1916–17 ..	640 5 11	41 1 6	3,360 0 10	3,041 7 11	180 9 6	3,080 12 0	453 6 2	90 15 0	..	5,438 4 10	22,391 10 2	2,811 14 6	41,530 8 4
1917–18 ..	1,609 9 7	29 0 0	2,709 14 4	3,664 11 11	331 15 0	2,388 14 7	325 6 2	25 2 0	10 8	28,737 15 10	22,680 0 7	2,910 7 4	65,417 12 0
1918–19 ..	9,630 3 11	31 6 0	2,875 14 7	11,339 7 6	1,953 0 10	4,326 11 1	297 3 0	681 3 6	.	26,849 8 4	31,704 8 7	6,327 11 5	96,016 14 9
1919–20 ..	16,297 6 0	1,622 6 9	2,342 3 3	11,821 15 9	3,554 14 11	5,691 12 7	614 1 0	24 9 6	.	27,728 7 6	28,431 3 4	5,938 0 4	1,04,067 0 11
1920–21 ..	12,050 14 2	2,560 1 3	1,211 12 5	8,870 11 3	1,173 6 6	1,057 1 5	124 14 0	114 11 6	..	6,589 9 5	32,314 5 1	2,329 9 6	68,397 0 6
1921–22 ..	22,064 11 6	5,374 12 8	3,853 12 3	6,276 13 5	605 15 0	1,139 2 7	295 13 5	..	..	7,418 7 4	49,476 0 2	2,732 14 8	99.238 7 0
1922–23 ..	24,252 1 0	6,814 9 0	3,220 8 7	5,905 1 5	1,053 3 3	1,577 13 5	408 5 2	17 2 0	29 10 0	8,507 14 0	58,937 10 2	1,906 7 4	1,12,630 5 4
1923–24 ..	16,744 12 2	5,117 6 11	2,346 12 2	3,718 9 5	758 3 9	5,092 3 0	976 5 6	2 0 0	..	5,297 6 8	58,705 11 1	1,625 5 0	1,00,384 11 8
1924–25 ..	18,459 9 0	3,898 0 0	2,353 7 0	3,852 12 11	1,228 1 0	7,119 14 1	493 13 7	165 11 0	..	4,377 11 5	63,837 11 6	1,814 3 1	1,07,600 14 7
1925–26 ..	25,725 9 6	3,186 10 3	2,303 10 6	6,810 9 9	808 10 6	4,302 9 8	1,029 5 6	2,847 6 0	..	3,478 10 0	66,086 8 8	2,546 8 5	1,19,126 2 9
1926–27 ..	31,833 6 3	5,321 15 0	2,284 1 10	7,458 3 2	3,981 14 9	3,181 14 9	3,285 12 0	1,303 10 3	1,800 0 0	4,468 11 7	63,852 13 6	3,248 11 4	1,32,021 2 5
1927–28 ..	33,503 1 10	4,530 6 3	1,965 8 0	10,865 3 3	7,589 4 6	5,386 3 0	287 6 6	1,474 9 6	..	3,709 1 0	55,816 14 9	3,240 1 0	1,28,367 11 7
1928–29 ..	45,318 10 6	1,242 6 3	2,062 1 0	12,890 8 0	6,340 3 6	4,598 5 3	388 11 0	259 12 0	...	3,363 9 10	61,454 11 0	3,269 7 3	1,41,188 5 7
1929–30 ..	52,159 13 10	2,846 11 6	1,714 9 6	12,845 12 10	1,979 6 4	3,192 14 0	101 6 0	126 9 0	..	6,497 14 6	32,604 13 0	373 3 9	1,14,443 2 3
Total ..	**3,10,290 3 2**	**42,616 13 4**	**34,604 4 3**	**1,09,362 0 6**	**31,538 13 4**	**52,136 3 5**	**9,081 13 0**	**7,133 5 3**	**1,834 4 8**	**1,42,463 4 3**	**6,48,294 9 7**	**41,074 8 11**	**14,30,430 3 8**
verage per nnum ..	**22,163 9 4**	**3,044 0 11**	**2,471 11 9**	**7,811 9 2**	**2,252 12 5**	**3,724 0 3**	**648 11 3**	**509 8 4**	**131 0 4**	**10,175 15 2**	**46,306 12 1**	**2,933 14 4**	**1,02,173 9 5**

Statement showing the financial position in the past.

Year.	Summary of Revenue. RS.	A.	P.	Summary of Expenditure. RS.	A.	P.	Profit. RS.	A.	P.	Loss. RS.	A.	P.
1916–17	49,155	15	6	41,530	8	4	7,625	7	2	..		
1917–18	53,847	15	9	65,417	12	0	..			11,569	12	3
1918–19	1,12,114	3	2	96,016	14	9	16,097	4	5	..		
1919–20	93,048	9	5	1,04,067	0	11	..			11,018	7	6
1920–21	76,022	6	2	68,397	0	6	7,625	5	8	..		
1921–22	60,730	12	3	99,238	7	0	..			38,507	10	9
1922–23	1,16,884	0	0	1,12,630	5	4	4,[illegible]	[illegible]	8	..		
1923–24	91,090	12	7	1,00,384	11	8				9,293	15	1
1924–25	1,21,483	5	7	1,07,600	14	7	13,[illegible]	[illegible]	[illegible]	..		
1925–26	95,665	7	6	1,19,126	2	9	..			23,460	11	3
1926–27	97,341	12	8	1,32,021	2	5	..			34,679	5	9
1927–28	81,470	3	10	1,28,367	11	10	..			46,897	8	0
1928–29	1,62,003	8	5	1,41,188	5	7	20,815	2	10	..		
1929–30	83,308	12	0	1,14,443	2	3	..			31,134	6	3

SECTION 7—OFFICERS IN CHARGE OF THE DIVISION.

258. The officers mentioned below have held charge of the divisions of South Kanara and (since 1916) of South Mangalore :—

Number	Name.	Designation.	Period.	Year Y.	months. M.
		SOUTH KANARA FOREST D[illegible]			
1	Mr. E. Thompson	Overseer, Sub-Assistant Conservator and then as Assistant Conservator.	October 1858 to December 1866	8	2
2	,, G. Cadell	Deputy Conservator on probation and later Assistant Conservator.	December 1866 to November 1868 ; March 1869 to April 1869.	2 0	0 2
3	,, H. P. Winter	Assistant Conservator	May 1869 to November 1870	1	7
4	,, J. W. Cherry	Do.	December 1870 to February 1872 October 1872 to June 1877 ; September 1877 to May 1878 ; and May 1880 to June 1880.	7	10
5	,, W. Carrell	Overseer and later Sub-Assistant Conservator.	May 1878 to May 1880 and June 1880 to July 1883.	5	1
6	,, H. Bradley, I.C.S.	As Assistant Collector and District Forest Officer.	September 1883 to April 1885	1	10
7	,, T. P. Peake	Assistant Conservator	April 1885 to July 1886 ; September 1886 to May 1889 ; and August 1889 to May 1892.	6	10
8	,, G. F. F. Foulkes	Do.	May 1892 to July 1894 and November 1894 to September 1895.	3	2
9	,, J. S. Battie	....	September 1895 to July 1898 and August 1898 to May 1899.	3	9
10	,, H. A. Latham	Deputy Conservator	September 1899 to February 1901 ; May 1901 to November 1902 and May 1903 to April 1907.	7	0
11	,, B. H. Barlow Poole	Do.	May 1907 to October 1908	1	6
12	,, D. T. Barry	Do.	October 1908 to April 1911 ; May 1911 to February 1912 ; and May 1912 to February 1913.	4	0
13	,, T. Clear	Assistant Conservator	February 1912 to May 1912	0	3
14	,, V. Raman Menon	Extra Assistant Conservator	February 1913 to October 1914 ; February 1915 to February 1916.	2	9
15	,, R. D. Richmond	Deputy Conservator	October 1914 to February 1915	0	4
		SOUTH MANGALORE FOREST DIVISION.			
16	Mr. J. H. Longrigg	Assistant Conservator	February 1916 to November 1916 ; January 1917 to November 1917 ; January 1918 to August 1918.	2	6
17	,, J. Sadasiva Ayyar.	Extra Assistant Conservator	December 1916 to January 1917 ; December 1917 to January 1918.	2	2
18	,, H. C. Bennett	Deputy Conservator	....	..	
19	,, J. Sadasiva Ayyar.	Extra Asistant Conservator	....	..	
20	,, A. R. Narasimha Ayyangar.	Do.	....	..	
21	,, G. S. Lasaroddo	Do.	4th May 1921 to 5th November 1921.	0	6
22	,, F. R. Madan	Deputy Conservator	5th November 1921 to 18th February 1926.	4	4
23	,, K. G. Belliappa	Extra Assistant Conservator	1st March to 25th May 1926	0	3
24	,, S. K. Basu	Assistant Conservator	26th May to 15th June 1926	0	1
25	,, K. G. Belliappa	Extra Assistant Conservator	16th June 1926 to 3rd January 1929.	2	6
26	,, V. G. Darrington	Deputy Conservator	3rd January 1929 to 10th June 1930.	1	5
27	,, E. V. Padmanabha Pillai.	Extra Assistant Conservator	11th June 1930 to ...	..	..

CHAPTER VI.—STATISTICS OF GROWTH AND YIELD.

SECTION 1.—STATISTICS RELATING TO TEAK.

259. Recorded data upon the rates of growth of teak in the division do not exist. No sample plots have been maintained and since the old teak plantations of Parappa have been felled, the only plantations of known age which remain are kumries in Kasaragod Range formed between the years 1904–14. Even here the specific years of formation are difficult, if not impossible to ascertain exactly in many instances, although approximate ages are known. Owing to past neglect of kumries, the size of teak trees therein can offer very unreliable data for general application. It is found that the average girths of teak trees in all kumries is approximately the same, viz., 1′ 6″ to 1′ 9″ at breast-height. During the course of reconnaissance for this working plan, the girth dimensions of about half a dozen of the best trees in certain kumries were measured and their heights estimated by eye, of which the following table gives averages :—

Name of kumri.	Year of formation (approximately).	Age in 1930.	Average girth at breast-height.		Average height of clear bole.		Average total height (approximately).	
(1)	(2)	(3)	(4)		(5)		(6)	
			FT.	IN.	FT.	IN.	FT.	IN.
Kanadichallu	1906	25	3	4	26	0	40	0
Nangoli (bit 1)	1906	25	3	5	25	0	44	0
Haspara (Madinadka Reserved Forest) ..	1912	18	2	4	26	0	36	0
Haspara, bit 1 (Aletti West Reserved Forest).	1906	25	3	6	28	0	50	0
Adapangaya	1906	25	2	10	20	0	37	0
Paimpachal	1906	25	2	8	30	0	43	0
Sheikpatti, bit 1	1906	25	2	8	29	0	41	0
Sheikpatti, bit 2			3	2	28	0	50	0
Anakollu	1914	16	2	4	23	0	35	0

SECTION 2.—STATISTICS RELATING TO *Hopea parviflora*.

260. *Measurements on young crops of known age.*—Sample plots have been maintained in all plantations of Hopea formed since 1922, and successive stages of growth have been measured annually by the divisional staff and recorded in the District office. The plotted data from certain plantations are shown at the end of this chapter. During the first decade the average rate of height-growth of a Hopea seedling established under a deciduous top-canopy with evergreen middle-storey appears to be in the neighbourhood of one foot per annum.

261. *Measurements on older crops*—(*a*) *Crops of known age.*—The oldest crop of known age is that located in Parappa teak plantation No. 1. The teak has now been realized, and the Hopea crop occupies the ground along with other miscellaneous species. The Hopea was planted in 1894–95 as an underwood to the teak when the latter was seventeen years old, but rapidly overtook the teak. A number of Hopea poles, dominant and dominated, were marked and numbered, and their diameters and heights have been measured at quinquennial intervals since 1911 and recorded in the office of the Provincial Sylviculturist. The numbers of trees recorded have varied slightly in different years, but this fact does not materially affect the averages, which are given in the table below. The site overlooks the Paiswani river between the 25th and 26th milestones on the Kasaragod-Jalsur Local Fund road and is on moderately deep soil varying from alluvium to laterite.

Year of measurement.	Age of crop.	Diameter measurements.			Height measurements.				
		Number of trees.	Total diameters.	Mean diameter.	Number of trees.	Total heights.		Mean height.	
(1)	(2)	(3)	(4)	(5)	(6)	(7)		(8)	
			INCHES.	INCHES.		FT.	IN.	FT.	IN.
1911	16	37	175·9	4·75	..	..		..	
1916	21	42	256·6	6·11	..	..		..	
1921	26	39	299·64	7·67	39	2,022	3	51	10
1927	32	38	373·45	9·83	39	2,397	0	61	5·5

The average height at which diameter measurements were taken is 4 feet 4·3 inches. Trees are numbered in paint and the actual point of measurement is marked by a cross on each tree.

262. (*b*) *Crops of unknown age.*—A total of 75 trees, selected and numbered in four different localities known as sample plots 2, 3, 5 and 6 of South Mangalore Division, have been periodically measured in similar fashion to the method described above, since 1921.

Their ages are unknown. The measurements having been hitherto recorded only twice, little advantage is secured in giving a detailed list. With but few exceptions, the diameters of the trees marked in each sample plot are very closely similar. In Parappa (sample plot 2), sixteen trees were measured in 1921; the mean diameter was 6·87 inches and the mean height was 49 feet 11 inches. In 1927, the mean diameter was 9·52 inches and the mean height was 56 feet 10 inches. The trees thus showed an increment of 2·65 inches in diameter and of 6 feet 9 inches in height in six years, or average annual increments of 0·44 inch and 1 foot 1½ inches respectively.

263. Similarly, thirty trees in Devachalla (sample plot 3) increased on the average from 18·09 inches to 19·42 inches diameter in the interval from 1922 to 1927, or 0·27 inch per annum; nine trees in Nalkur reserve near Panjipalla (sample plot 5) increased on the average from 30·49 inches to 31·29 inches in the same period, or 0·133 inch per annum; and twenty trees near Yeradka (sample plot 6) increased from 17·9 inches to 18·75 inches, or an average of 0·14 inch. It is significant to note that the trees in Parappa, on riverain alluvium adjoining mixed deciduous forest put on far bigger increments than those in the other three plots which are in semi-evergreen forests of the foothills, described as first-class soil. The trees in Parappa are however considerably younger. On the other hand, three trees of larger dimensions in Parappa reserve, not immediately on the river-bank were also measured. A tree (marked 'X') near cairn No. 183 in compartment No. 4 of Parappa measured 6 feet 11¼ inches girth in March 1917 and on re-measurement in March 1927 was found to be 7 feet 10 inches, showing a girth-increment of 10¾ inches (approximately 3·42 inches diameter-increment) in ten years. Similarly a tree (marked 'Y') near the east boundary of teak plot 1, girth 5 feet 5 inches at 6 feet above ground in 1921, showed a girth-increment of 1 foot 4⅝ inches in the same period (approximately 5·3 inches diameter-increment); and a tree (marked 'Z'), near teak plot 2 girth 4 feet 7½ inches at 7 feet above ground in 1921, put on 1 foot 6⅞ inches corresponding to a diameter increase of 6·01 inches in the ten years.

264. Summarizing, it would appear that Hopea trees standing on good deep alluvium or clay put on an annual increment in the neighbourhood of 0·5 inch diameter (or about 1·5 inches girth); and that on more rocky soils, the average annual increment is about 0·22 inches diameter, or say 0·7 inches girth. The average annual height-increment of a growing pole appears to be between 1 foot and 1 foot 6 inches.

Section 3.—Growth of Coppice Shoots.

265. A table is given below showing the results of measurements made in Narimogar reserve on the growth of coppice-shoots of miscellaneous species :—

Number of coupe.	Year of felling.	Age of coppice shoots.	Average girth in inches of coppice shoots.	Mean annual increment.	Remarks.
(1)	(2)	(3)	(4)	(5)	(6)
			INCHES.	INCHES.	
1	1914–15 ..	15	10⅞	0·72	Date of measurement 12th May 1930.
2	1916–17 ..	13	7½	0·57	
3	1917–18 ..	12	7¼	0·60	
4	1918–19 ..	11	4 2/7	0·39	
5	1919–20 ..	10	6½	0·65	Measurements taken at breast-height.
6	1920–21 ..	9	6⅓	0·70	
7	1921–22 ..	8	5⅞	0·73	
8	1922–23 ..	7	5 3/5	0·80	
9	1924–25 ..	5	5 4/5	1·16	
10	1925–26 ..	4	4½	1·12	Measurements taken at 1′ above-ground.
11	1926–27 ..	2	3⅞	1·93	
12	1927–28 ..	2	3¾	1·87	

Section 4,—Volume Tables.

266. From the recorded results of past fellings in various localities, it has been possible to make a start in the compilation of volume tables for the crops of the division. The figures are as yet greatly inadequate; in Mujur and Sampaje, two of the most important felling localities for the future, the results of only one coupe in each are available, and the numbers of trees felled especially those of higher girths, are extremely meagre and correspondingly untrustworthy in their average yields. In Mujur reserve moreover, the locality exploited is not typical of the major part of the reserve, the coupe being of low-lying and moist deciduous type where *Xylia xylocarpa* did not flourish. Nevertheless a fairly definite relationship between the several girth-classes of various common species and their corresponding average net (converted) log yields is evident in the majority of cases, so that it has

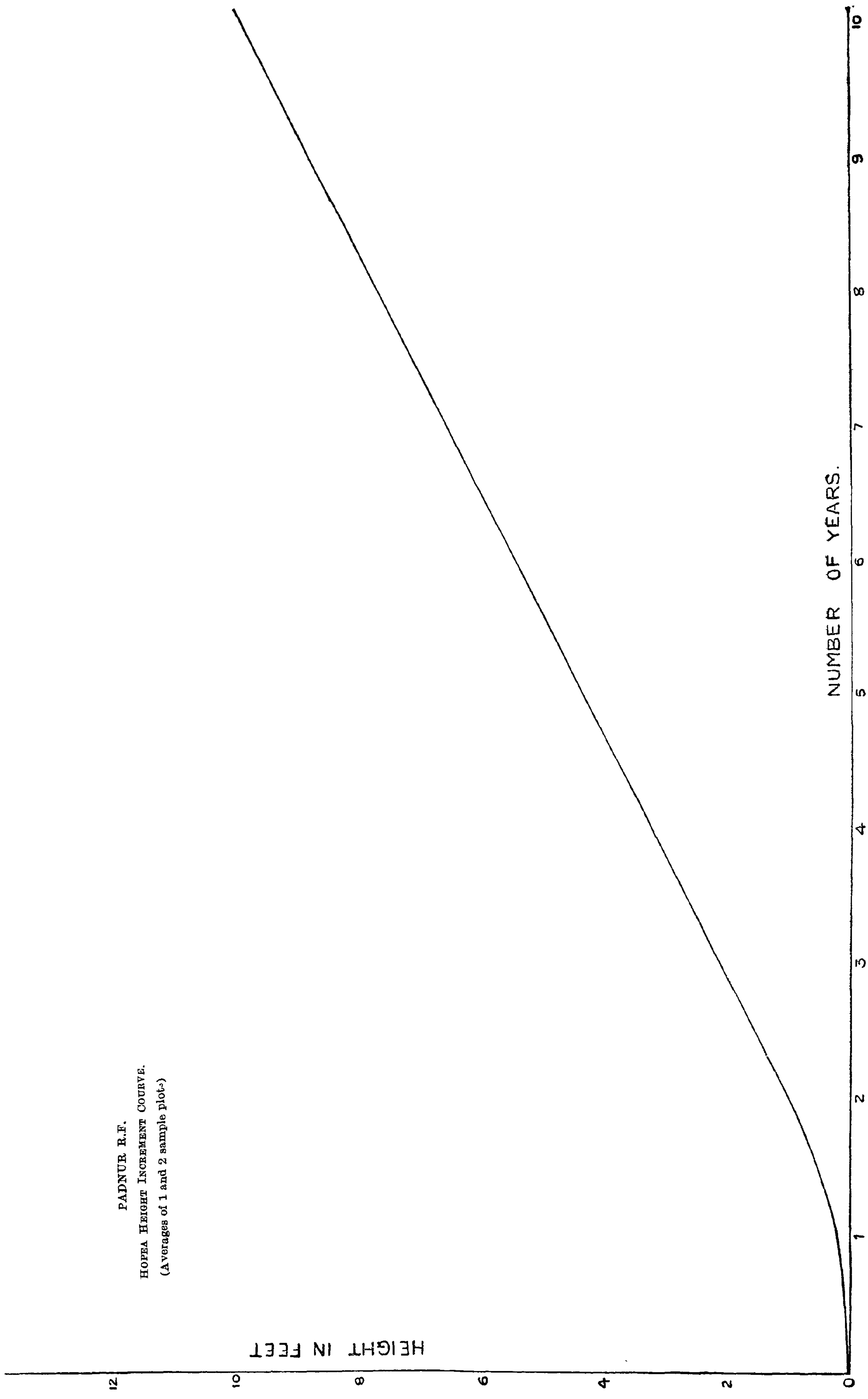
been possible to construct curves which must approximate fairly closely to actual figures of outturn. There is rarely any large divergence between results obtained in various localities when the curves for each species are compared. This would point to a fairly constant quality-class of soil throughout the major timber-bearing areas. The main difference is found in the surprising superiority of *Terminalia tomentosa* outturn in Nalkur reserve over quantities obtained from corresponding girths of that species elsewhere. This may be ascribed firstly to superior soil conditions (and corresponding height of bole) and perhaps to immunity from fires, which detract so much from the soundness of timber obtained in the less fortunate dry localities. The figures obtained for Parappa reserve, owing to the greater number of trees felled there, are by far the most reliable for all species yet examined, and approximate most closely to the average curve. Mean curves for the whole division have also been drawn, and recorded in the office of the Conservator, Working Plans Circle.

267. From the curves of divisional averages have been read off the volumes given below in tabular form for each girth-class. These figures will doubtless be improved upon. At present no attempt is made to separate quality classes, but in the case of *Terminalia tomentosa* the Parappa results have been adopted as the standard, rather than mean divisional averages which are affected by the Nalkur results.

268. *Volume outturn tables*—

Girth class in feet.	Volume of converted timber in cubic feet.					
	Teak.	Terminalia tomentosa.	Terminalia paniculata.	Xylia xylocarpa.	Lagerstrœmia lanceolata.	Hopea parviflora.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
	C. FT.	C. FT.	C. FT.	C. FT.	C. FT.	C. FT.
2–3	8	8	8	10	9	15
3–4	15	14	13	16	17	27
4–5	25	20	21	23	26	43
5–6	37	28	30	32	36	62
6–7	55	38	40	43	45	88
7–8	..	48	51	56	55	128
8–9	..	59	..	..	65	174
9–10	..	71	..	..	..	220
10–11	..	..	..	..	..	264

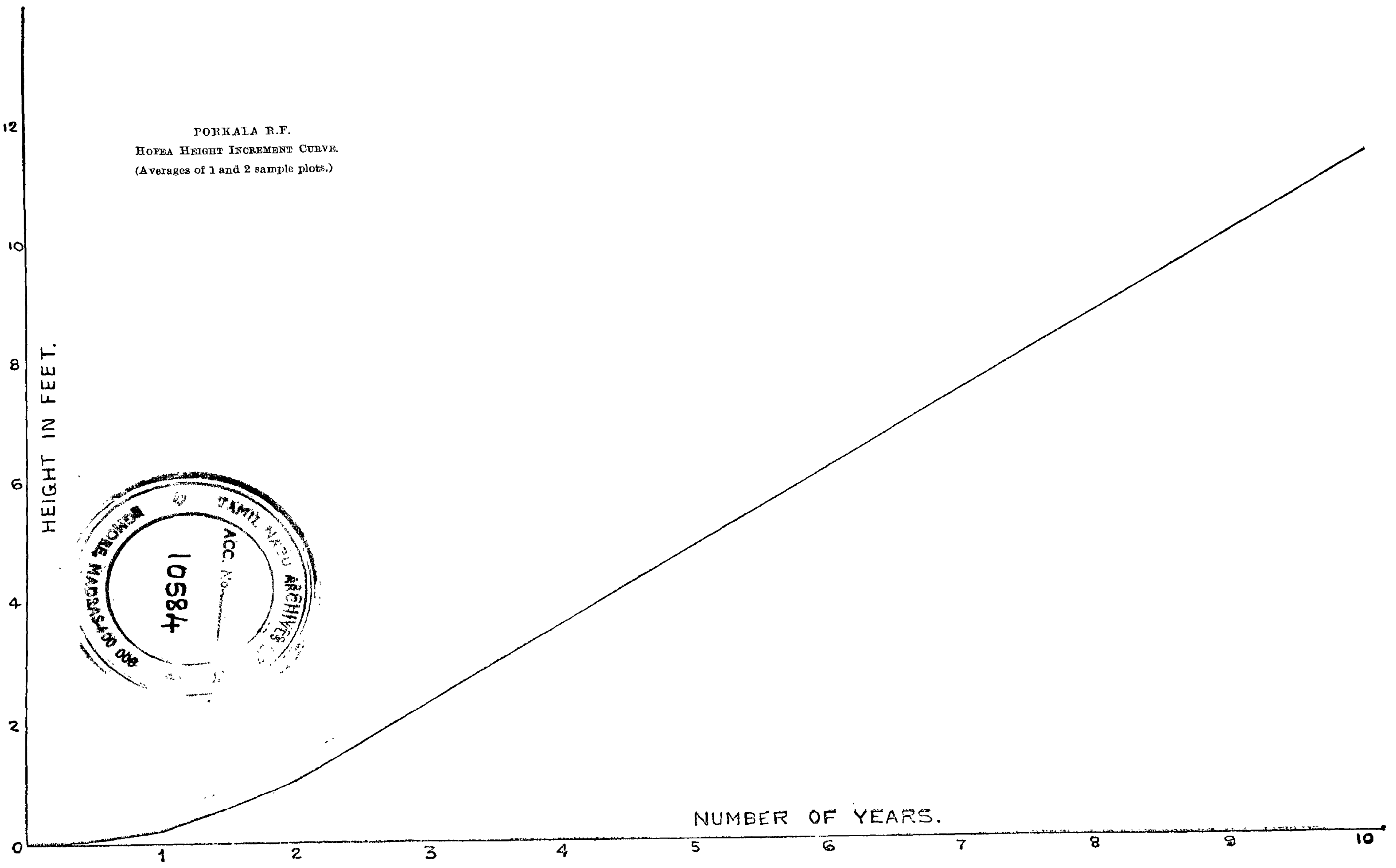
269. *Ring countings.*—A counting of annual rings on some half-a-dozen stumps of each of the common deciduous species was made at Sampaje during the course of fellings. Except in the case of teak and *Dalbergia latifolia* on which the rings were fairly distinct, results are thought to be insufficiently reliable. *Terminalia paniculata* appeared to be the fastest-grown, giving an average of about 0·87 inch girth increment per annum at breast-height. Teak showed an average annual girth increment of 0·75 inch and *Dalbergia latifolia* 0·83 inch. All trees examined were between 60 and 80 years old. These figures are not intended to be of any practical utility.


PADNUR R.F.
HOPEA HEIGHT INCREMENT COURVE.
(Averages of 1 and 2 sample plot.)
HEIGHT IN FEET
0
2
4
6
8
10
12
NUMBER OF YEARS.
1
2
3
4
5
6
7
8
9
10

PORKALA R.F.

HOPEA HEIGHT INCREMENT CURVE.

(Averages of 1 and 2 sample plots.)



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CHAPTER VII.—CAPITAL VALUE OF THE FORESTS.

270. An estimate of the present capital value of the forests of South Mangalore Division is not possible to arrive at. Past records deal with such comparatively small areas, and the majority of forest terrain is so complex and irregular in its natural state, that all attempts to assess its value in monetary terms would be in all probability misleading, and so no attempt is made.

Part II.

Future Management discussed and described.

CHAPTER I.—BASIS OF PROPOSALS.

SECTION I.—GENERAL OBJECTS OF MANAGEMENT AND BRIEF DISCUSSION OF TREATMENT REQUIRED TO SECURE THEM.

271. The principal objects of management are the following :—

(i) The maintenance of a well-regulated water-supply to the district by the effectual protection of the forests, clothing the upper catchment areas of all principal river systems. This is of primary importance in a country receiving more than 200 inches of rain per annum, and possessing only a narrow seaboard for the drain-off of surplus water. The irregular protective nature of the ghats and foothill jungles should never be endangered by intensive fellings on a large scale.

(ii) The maintenance and improvement of the fertility of the soil in forest reserves. The importance of vegetational cover to South Kanara soils has been emphasised in Part I of this Plan. Fires and unregulated fellings must be minimized in order to achieve this purpose.

(iii) The progressive development of the more important forest reserves in order to attain within the shortest possible period a maximum annual yield per acre in perpetuity of species expected to yield the highest net monetary return to the State. The extent and distribution of forest conservances in the division are such that the practical attainment of this ideal throughout is not in sight, nor is it contemplated within the general scope of this plan. An approach towards a better distribution of age-classes and a greater proportion of utilizable species is aimed at within regions which can be readily manipulated and which justify expenditure on development.

(iv) The systematic improvement by sylvicultural measures, of the value and condition of the forests as a whole. The present inferior quality of the stock and of the timber extracted is due principally to past disabilities and maltreatment prior to reservation. This is being remedied by protection. Under skilled management, as much as possible of the existing crops will be progressively harvested and replaced by selected species grown under the most advantageous conditions possible, from the outset. In the application of improvement measures which involve no immediate compensating returns in the shape of revenue, it is considered that money will be more effectively spent on young crops which can be protected and tended throughout their life with a view to the production of first-class timber, rather than on improvements to standing timber, unless the latter be of exceptional vigour and utility. Expenditure on improvements must be concentrated on those species of first quality only, which find markets outside South Kanara. It happens that many areas at present comparatively useless, are now in process of being restocked naturally with *Hopea parviflora* and to a less extent with *Artocarpus hirsuta,* both of which timbers are almost the equal of teak and are much faster-grown in this district. These species are greatly benefited by artificial assistance during early stages and readily repay timely attention at relatively low cost. The Working Plan has prescribed work in such localities.

(v) Continued experimentation in methods of raising valuable species to the best advantage by artificial means.

Our success in the artificial regeneration and establishment of species other than *Hopea parviflora* during the past has not been pronounced. Experience hitherto has been chiefly negative and definite information on costs of formation and the most desirable measures requisite for success is lacking. Evergreen species such as *Dipterocarpus indicus* and *Mesua ferrea* ought not to be difficult to raise at lower elevations since the climatic variations of temperature and humidity within the district are slight. Similarly for deciduous species, few facts are on record. The method of clear-felling and artificial regeneration

has been shown to give initially satisfactory results but experience in subsequent treatment and costs of establishing such a crop has been meagre. Owing to the inevitable sacrifice which must be made in the process of clear-felling and the usually higher costs of establishment, it is proposed to entertain this method only on a small experimental scale for the first period of the plan, and to concentrate on the raising of species such as teak and rosewood (*Dalbergia latifolia*) with such supplementary crops of other species as may appear desirable.

Section 2.—Working Circles, their Area and Distribution.

272. Eight working circles have been formed :—

(1) The Plains and Foothills Timber Working Circle.

(2) The Protection Working Circle.

(3) The Plantation Working Circle,

(4) The Hopea Improvement Working Circle.

(5) The Clear-felling (Experimental) Working Circle.

(6) The Fuel Working Circle.

(7) The Minor Produce Working Circle and

(8) The Sandal Working Circle.

(1) *The Plains and Foothills Timber Working Circle.*

273. This Working Circle embraces selected tracts in the plains and foothills which should be exploitable at a small but reasonable margin of profit under normal conditions, at maturity. It covers all types of forest. This circumstance cannot possibly be avoided, owing to the very frequent mergence of one type into another, and the difficulty of finding extensive forests of uniform character. It has been found possible in most cases however, to put broadly similar tracts of forest within single units of working for the time being, so that some continuity of treatment is generally feasible.

274. The total extent and distribution of the Timber Working Circle is only loosely defined. No real object is to be served by apportioning exact limits to this circle which must for a long period ahead be limited to a small proportion only of the entire extent of forest in the Division, so that a vast technical reserve remains available for tapping as occasion permits.

The least area of ' accessible ' timber forest which might be deemed in time suitable for the axe is in excess of present requirements ; on the other hand considerable areas also exist which although at present somewhat too remote or difficult for immediate working contain a very good proportion of mature stocking. These latter areas might well be brought within accessible limits and repay extraction within a measurable period as roads and markets developed. The task of selecting definite areas for permanent inclusion within the Timber Working Circle, while excluding others, thus becomes almost impossible within the limits at present imposed by the ordinary requirements of management. If such a course were undertaken, it would most certainly be open to very frequent revision subsequently, and its value accordingly nullified.

275. All that the present plan is directly concerned with is the area which will come under felling and regeneration within the next 30 years. It is found that this is easily provided from within the three ranges of Kasaragod, Puttur and Uppinangady, while the crops in Beltangady Range are on the whole insufficiently matured to merit their exploitation on any considerable scale. For the purposes of administration and management a redistribution of reserves to the first three ranges above named has therefore been effected (vide paragraphs 615 to 617) in ' Miscellaneous prescriptions.'

276. It is desirable for the facilitation of future revisions that, in addition to areas now defined as suitable for regeneration during the first period of the plan, other localities containing fair or good timber-growth, suitable for future regeneration, should be indicated on the Working Plans maps. This has been done. A distinction has been shown between localities at present accessible (but preponderatingly immature), and inaccessible (although in some cases more mature). Such areas have not been enumerated. They correspond to a *suggested* " second periodic block," or better, a " quartier jaune " under the Uniform System. They will require more detailed examination at revision. Selected blocks of forest may be added to the present regeneration area to accommodate increased markets at any time. It is a good thing to keep an area in view for future working at least equal in size to the current regeneration area, which will in due course replace it.

277. In summary, the areas now definitely included in the Timber Working Circle, and those areas which may in future be susceptible to similar treatment are classified roughly in the following four groups :—

Areas now definitely allotted to the Timber Working Circle are—

(A) Areas now selected for regeneration (first period).

	ACS.
Kasaragod Range—	
Sampaje ..	819
Aletti East ..	90
Aletti West ..	307
Medinadka West ..	269
Puttur Range—	
Jalsur East ..	384
Nalkur ..	4,621
Devachalla ..	640
Arantakallu ..	461
Bantamale ..	1,075
Yenmuru ..	1,472
Uppinangady Range—	
Mujur ..	1,639
Total ..	11,777

(B) Areas suggested for future regeneration (second period).

Kasaragod Range—	
Sampaje ..	1,151
Todikan ..	1,011
Medinadka East ..	243
Aletti West ..	768
Kanakamajulu ..	486
Puttur Range—	
Nalkur ..	233
Devachalla ..	934
Bantamale ..	166
Yenekal ..	115
Balpa ..	512
Anegunde ..	1,293
Jalsur West ..	320
Kaniyarmale ..	1,690
Mundekole ..	1,024
Uppinangady Range—	
Mujur ..	870
Kidu ..	1,331
Kombar ..	1,242
Kadimbilla ..	243
Shibaje ..	870
Total ..	14,502

Areas now in the Protection Working Circle (vide 2) which are suggested for future inclusion in the Timber Working Circle are :—

(C) Accessible timber areas not included in (A) or (B) above but susceptible of future inclusion in the Timber Working Circle.

Kasaragod Range—	
Medinadka West ..	1,253
Todikan ..	1,023
Aletti West ..	1,779
Puttur Range—	
Jalsur West ..	1,471
Uppinangady Range—	
Porkala ..	3,410
Padnuru ..	2,506
Shibaje ..	1,878
Shiradi Shisla (Part) ..	3,953
Dharmastala Mundaje ..	2,165
Kadimbilla ..	300
Total ..	19,738

(*D*) *Well-stocked timber areas at present inaccessible but possibly susceptible of future development and exploitation under the Timber Working Circle.*

	ACRES.
Kasaragod Range—	
Sampaje	1,767
Medinadka West	461
Puttur Range—	
Kilaramale	1,152
Kiribag	2,918
Subrahmanya	1,024
Uppinangady Range—	
Mujur	1,306
Kombar	333
Konaje	1,011
Shiradi	451
Nidle	2,153
Dadanthamale	909
Charmadi-Kanapadi (part)	1,024
Dharmastala Mundaje	3,712
Total ..	**18,221**
Grand total of areas (A) and (B)	**26,279**
Grand total of areas (A), (B), (C) and (D)	**64,238**

Note.—By the term ' accessible ' is meant those blocks which are at present accessible from a road capable of taking timber traffic, or which adjoin a navigable river.

(2) *The Protection Working Circle.*

278. The forests of the principal ghats and remoter localities of the foothills, reserves in Kasaragod Range under settlement, small isolated reserves of no great present importance, coastal reserves containing degraded scrub not utilizable for fuel, areas recently kumried, and in short all localities within reserved forest boundaries not directly utilizable at present, or provided for under any specific prescriptions of this working plan (except for Hopea improvement) are classed as ' Protection forests.'

279. The approximate area and distribution is as follows :—

Name of range.	Area in acres.
Kasaragod	51,054
Puttur	54,404
Uppinangady	109,586

280. This working circle does not include small scrub and grassy areas adjoining pattas which for purposes of management are more conveniently included within the boundaries of the Timber Working Circle when the rest of the compartment is so included.

(3) *The Plantation Working Circle—Area* 4,781 *acres.*

281. To this working circle are assigned all plantations of over 3 acres in extent, which have been formed prior to 1930–31, surveyed teak kumries, and established Hopea plantations under shelterwood.

282. These plantations, whatever their origin, are grouped together to form a separate working circle, since they form even-aged crops in contrast with the uneven-aged woods which typify the major portion of the division. Most of these have been experimental, varying espacements and modes of formation having been adopted with varying degrees of success. They provide useful growth—data, and information—at present incomplete—on the costs of establishing different crops on various classes of soil. Many of the plantations require individual treatment not conveniently provided for in the prescriptions for other working circles.

(4) *The Hopea Improvement Working Circle—Area* 4,247 *acres.*

283. Many localities, not at present possible of inclusion directly within the normal processes of regeneration and tending prescribed for the Timber Working Circle, contain young crops of *Hopea parviflora* in various stages of advancement. Attention to such

areas would be well merited, since timely assistance will effect the survival and advancement of seedlings and saplings during the precarious stages of early youth, which in most cases will eventually supplant the worthless vegetation at present occupying the ground. The working circle will also include all broadcast-sown plots or artificially regenerated areas of an otherwise unregulated nature undertaken from time to time in seasons particularly favourable to the introduction of Hopea, e.g., in years of prolific seed-fall. It will therefore overlap portions of the Timber and Protection Working Circles. In due course, areas so dealt with should be embraced within the normal provisions of the Timber Working Circle, or otherwise provided for.

(5) *The Clear-felling (Experimental) Working Circle—Area* 304 *acres (excluding kumries).*

284. This circle is formed with the object of providing for each range a small area each year to clear-fell and restock with desirable deciduous species. Owing to the greater expense usually involved by clear-felling methods, especially in subsequent tending and weeding, areas selected possess generally a reasonable crop of utilizable timber, but for purposes of experiment different types of soil have been included. The principal object will be to raise teak crops, and areas have as far as possible been selected with this in view, but it is not intended that the soil should everywhere be accepted as suitable for teak, nor that this species should be introduced without discrimination. Other species along with teak are in fact desirable, and this is provided for.

285. Certain areas have been also selected for kumri work. Such areas are essentially non-productive at present of any appreciable tree crop of value, being covered by bamboo or useless 'kochi' regrowth from old clearings made about 40 years ago, and incapable of further development owing to the multitude of climbers present. Kumri working, the continuance of which is meant to be entirely provisional upon a reasonable degree of success in the first few years, will constitute a separate series. Almost no sacrifice is involved in effecting a clearance of the existing growth, and there is a prospect of vast improvement at low cost in the resultant crop obtained. No great stress is placed upon the value of labour attracted to this class of work, but it is conceivable that once the method has been demonstrated to work with success, competition for grants of land for this purpose may improve labour conditions in remoter localities. The foot of formerly kumried hill-ranges, minor slopes of northerly or westerly sheltered valleys, are considered preferable for this 'kumri series.' It is intended that teak should again be the principal crop to be raised and typical *Xylia* areas should be excluded. General limits of this series for future felling have been indicated on the maps, but as the character of the growth and quality of the soil vary considerably from place to place, it is necessary again that the management exercise discrimination in the actual selection of coupes year by year. If the soil is expected to be unsuitable for teak, other species, especially *Dalbergia latifolia, Pterocarpus Marsupium* and *Terminalia tomentosa,* are to be tried. Very satisfactory results have been obtained by the Coorg Forest Department at Sampaje in the production of pure *Dalbergia latifolia* crops from kumri, and—to slightly less degree—with *Pterocarpus Marsupium* also.

(6) *The Fuel Working Circle.—Area* 4,399 *acres.*

286. No more than the reserves at present under working for fuel will be included in this working circle, with the exception of Karadka. Some of these reserves are already under separate working plans, the provisions of which have been incorporated as far as possible in the present plan.

(7) *The Minor Produce Working Circle.*

287. This circle covers the forests and unreserves of the entire division.

(8) *The Sandal Working Circle.*

288. The extraction of sandalwood from certain unreserved lands, village porambokes, kumakies, etc., is regulated in this working circle, and the propagation of sandal in a few reserves is prescribed as an experimental measure.

SECTION 3.—PERIOD OF THE WORKING PLAN AND ITS FUTURE REVISION.

289. The working plan will take effect from 31st March 1931. It is shown however in paragraphs 306 and 307 that administrative convenience in the working of mature and overmature timber from Government unreserves and wastelands will postpone the application of many of the prescriptions of the Timber Working Circle applying to extraction and regeneration in the more important reserves for a somewhat indefinite period, which is roughly estimated at five years. The prescriptions for the other working circles will however be applied from the commencement of the plan. The present framework of the plan

enjoins the necessity for frequent revisions, preferably at decennial periods. Although many of the prescriptions may have taken little practical effect by the close of the present decade, it would be unwise to postpone revision later than the year 1941, and preferably this should be begun in the previous year so that continuity is not lost.

CHAPTER II.—WORKING PLAN FOR THE PLAINS AND FOOT HILLS TIMBER WORKING CIRCLE.

SECTION 1.—GENERAL CONSTITUTION OF THE CIRCLE AND CHARACTER OF THE VEGETATION.

290. *Area.*—The Timber Working Circle now covers an area of 26,280 acres. A total extent of about 65,270 acres are susceptible of inclusion ultimately, but with present timber prices, present communications and present marketing facilities, such an area is now neither practicable nor necessary. Additions may be made to the total area at the time of future revisions.

291. *General constitution.*—This working circle comprises mixed irregular high forest of deciduous evergreen and intermediate types, frequently in close association. Some of this is natural forest comparatively unmodified by human disturbance, but the majority is secondary growth, largely of deciduous species, subsequent to old 'kumri' clearings. The tracts at present embraced within this working circle are the most mature and the best-stocked areas that can be found up to the very limits of present economic exploitability. The younger crops are composed of irregular-sized groups of somewhat even-aged appearance. In the older crops, while the grouping of ages is still to some extent apparent, accidents to the upper canopy have permitted younger individuals to occupy the gaps. Those compartments which are now nearest to maturity possess a considerable range of age-classes and are noticeably irregular even among comparative light-demanding species while evergreen localities approximate closely to the so-called 'selection' type containing all ages on a single unit of area. Trees of exploitable girth are accordingly only a fraction, and often an inconsiderable fraction numerically, of the total number of stems on the ground. Again, the proportion of stems of utilizable species varies considerably from one locality to another. The principal factors which qualify the utility of these forests are—

(i) the wide variety of species, especially in sub-evergreen and evergreen localities, many of which are not utilizable at present;

(ii) the decreasing number of species which can be extracted from interior coupes at a remunerative cost, as the leads to markets become greater and the difficulties correspondingly enhanced. Natural regeneration occurs under partial shade, and is determined both as regards quantity and quality chiefly by the condition of the undergrowth which is itself the outcome of local physiographic and edaphic factors—moisture, aeration, acidity, texture, etc., and the past history of the locality. All conditions of undergrowth are present, these having been already described in paragraphs 61–64 of Part I. It is significant that at the point whereat deciduous timber species fail to accomplish their regeneration naturally, evergreen species introduce themselves spontaneously, or may generally be installed artificially with success. The principal utility species dealt with at present are *Terminalia tomentosa, Terminalia paniculata, Lagerstrœmia lancœlata, Dalbergia latifolia, Xylia xylocarpa, Hopea parviflora* and *Artocarpus hirsuta*. Teak is absent in most of the forests.

SECTION 2.—DIVISION OF THE AREA.

292. The unit of management is the regeneration area, which will be liable to revision and reconstitution every ten years (vide paragraph 322).

293. The working circle as a whole comprises various blocks of forest having local names, but some blocks will only partially be included in the circle. The working circle is shown on the 'Management maps' in red.

294. No permanent compartments have been formed or demarcated. The area has been subdivided into temporary compartments for the purposes of description. These are bounded as far as possible by natural features, cut lines being avoided for the sake of economy.

295. Annual coupes, denoted by roman numerals, coincide occasionally with entire compartments, but where in practice this is impracticable, the coupe will be defined by cut lines. No very permanent value attaches to the serial number of a coupe, but the year of felling will be shown on boards of durable timber fixed securely at the corners of the coupe. When the coupe is again felled over the year of felling will be shown underneath the year of initial felling. Numbers will be deeply cut and then painted.

296. Four felling series have been defined. These are given in paragraph 334.

SECTION 3.—ANALYSIS AND VALUATION OF THE CROP.

297. *Stock-mapping.*—The entire area of the working circle has been stock-mapped and shown on Survey of India sheets to the scale of two inches to one mile. Larger scale maps on four inches to one mile have been prepared for those areas which are to be felled over during the first ten years of the first cycle of operations. Advance growth and natural regeneration of important species in perceptible quantity has been indicated, where possible.

298. *Enumerations and analyses.*—The crops have been enumerated over various proportions of the total areas, varying from 20 to 100 per cent, the usual proportion being in the neighbourhood of 30 per cent. Between November 1929 and January 1931, 1,938 acres were enumerated, representing a total extent of 7,525 acres. Species not of marketable value were not enumerated, but species in certain evergreen localities (viz., Bantamale reserve), which although at present unmarketable might conjecturably become so, e.g., *Dipterocarpus indicus, Dichopsis elliptica, Cedrela Toona, Eugenia Gardneri, Calophyllum tomentosum,* were listed, since a knowledge of the volumes of these timbers present would be of great practical advantage to the Department, and add very considerably to the scope of the fellings, if and when markets are obtained for these species. The following tabulated statement shows the numbers of trees of known value in the various felling series, their estimated volumes, and the percentage basal areas represented by the several girth-classes. It is readily observed that the bulk of the trees even in these so-called 'mature' areas are still found in the 3′–4′ and 4′–5′ classes. Immature areas have not been enumerated, but in these by far the greater proportion are to be found in the 2′–3′ and 3′–4′ classes. The preponderating bulk of the crops in this working circle will therefore begin to pass into exploitable limits between 1945 and 1960.

Analysis of Crop.

A.—Evergreen and Sub-evergreen.

Name of reserve and range.	Girth classes.	Number of trees and percentages above and below exploitable limit of six feet.									Basal area percentages above and below exploitable limit of six feet.					
		All species.			Hopea parviflora.			Mesua ferrea.			All species.		Hopea parviflora.		Mesua ferrea.	
		Number.	Per cent.	Total per cent.	Number.	Per cent.	Total per cent.	Number.	Per cent.	Total per cent.	Per cent.	Total per cent.	Per cent.	Total per cent.	Per cent.	Total per cent.
Kasaragod Range.																
	FEET															
Aletti East Reserved Forest	3–4	71	22·9	62	37	20·4	53	..	..	..	8·1	33	6·4	22	..	..
	4–5	72	23·2		33	18·2		..	..	..	13·6		9·4		..	..
	5–6	50	16·1		26	14 3		..	..	..	10·9		6·6		..	..
	6–7	28	9·0	38	15	8·2	47	..	..	..	10·8	67	9·3	78	..	..
	7–8	24	7·7		15	8·2		..	..	..	12·5		11·9		..	..
	8–9	65	20·9		55	30·3		..	..	..	43·8		56·5		..	..
	over 9.	..	..		..	..		..	..	..	..		..		..	..
Puttur Range.																
Bantamale Reserved Forest	3–4	1,053	42·0	82	407	54·1	93	32	17·2	58	19·8	58	34·7	82	5·5	31
	4–5	659	25·9		215	28·5		44	23·9		21·2		30·5		12·6	
	5–6	347	13·8		79	10·5		31	16·6		16·6		16·5		13·3	
	6–7	170	6·7	18	29	3·8		27	14·5	42	11·4	42	8·3	18	16·0	69
	7–8	117	4·7		11	1·4		22	11·8		10·4		4·2		17·6	
	8–9	74	2·9		5	0·6		14	7·4		8·5		2·3		14·4	
	over 9.	81	3·2		6	0·7		16	8·4		11 7		3·5		20·5	
Aranthakallu Reserved Forest	3–4	505	35·3	81	36	27·2		..	..	..	17·1	60	10·1	39	..	..
	4–5	422	29·5		19	14·3		..	..	..	33·6		9·0		..	..
	5–6	236	16·4		28	21·2		..	..	..	19·1		19·4			
	6–7	141	9·8	19	23	17·4	37	..	..	..	16·3	40	22·3	61	..	..
	7–8	73	5·1		13	9·8		..	..	..	11·3		16·8		..	..
	8–9	49	3·4		12	9·0		..	..	..	10·7		20·0		..	..
	over 9.	7	0·4		1	0·7		..	..	..	1·7		2·0		..	..
Nalkur Reserved Forest	3–4	791	19·5	80	157	26·7	69	..	..	..	9·0	59	10·6	43	..	..
	4–5	1,580	39·0		148	25·2		..	..	..	27·6		15·9		..	..
	5–6	872	21·2		98	16·6		..	..	..	22·4		16·3		..	..
	6–7	411	10·1	20	66	11·2	31	..	..	..	16·2	41	15·3	57	..	..
	7–8	189	4·6		50	8·5		..	..	..	10·3		15·6		..	..
	8–9	148	3·6		48	8·1		..	..	..	9·6		19·1		..	..
	over 9.	59	1·4		29	3·4		..	..	..	4·8		7·0		..	..
Devachalla Reserved Forest	3–4	785	39·4	86	162	42·0	85	..	..	..	21·2	69	22·0	64	..	..
	4–5	615	30·8		109	29 0		..	..	..	27·3		24·2		..	..
	5–6	319	16·0		54	14·0		..	..	..	20·9		18·0		..	..
	6–7	172	8·6	14	35	9·0	15	..	..	..	15·8	31	16·2	36	..	..
	7–8	48	2·5		7	1·7		..	..	..	5·9		4·5		..	..
	8–9	49	2·4		15	3·4		..	..	..	7·8		11·0		..	..
	over 9	4	0·01		3	0·7		..	..	..	1·0		3·8		..	..

Analysis of Crop.

B. Deciduous and Sub-evergreen (Hopea parviflora).

Name of reserve and range.	Girth classes.	Number of trees and percentages above and below exploitable limits. — All species. — Number.	All species. — Per cent.	All species. — Total per cent.	Hopea parviflora. — Number.	Hopea parviflora. — Per cent.	Hopea parviflora. — Total per cent.	Xylia xylocarpa. — Number.	Xylia xylocarpa. — Per cent.	Xylia xylocarpa. — Total per cent	Basal area percentages above and below exploitable limits. — All species. — Per cent.	All species. — Total per cent.	Hopea parviflora. — Per cent.	Hopea parviflora. — Total per cent.	Xylia xylocarpa. — Per cent.	Xylia xylocarpa. — Total per cent.
	FEET.															
Kasaragod Range.																
Jalsur East Reserved Forest	3–4	915	55·0		1	11·1		575	66·7	67	35·7		4·3		50·8	51
	4–5	440	26·4	81	3	33·3	67	203	23·5		28·2	64	21·6	47	29·6	
	5–6	204	12·2		2	22·2		70	8·1		19·5		21·6		15·2	
	6–7	67	4·0	19	1	11·1		11	1 2	33	9·5		12·3		3·3	49
	7–8	24	1·4		2	22·2	33	1	0·1		4·2	36	39·2	52	0·3	
	8–9	12	0·8		..	..		1	0·1		2·7		..		0·5	
	over 9.	1	..		..	..		..	..		..		..		..	
Sampaje Reserved Forest	2–3	4,525	54·9		..	..	..	3,183	64·7		21·7		..	..	34·0	
	3–4	1,950	23·6	95	..	..	..	916	18·3	83	18·5	62	..	..	21·0	55
	4–5	1,443	17·0		..	..	..	530	10·8		22·2		..	..	24·7	
	5–6	828	2·6		..	..	..	206	4·1		19·1		..	..	12·6	
	6–7	301	1·5		..	..	..	54	1·1	17	9·6		..	..	4·4	44
	7–8	129	0·2	5	..	..	..	12	0·2		5·8	38	..	..	1·1	
	8–9	52	0·01		..	..	..	5	0·1		2·8		..	..	0·7	
	over 9.	7	0·002		..	..	..	..	..				..	..	..	
Medinadka West Reserved Forest ..	2–3	1,055	41·6		..	..	..	556	46·3		14·2		..	..	20·3	
	3–4	800	31·5	87	..	..	..	419	34·9	81	26·0	58	..	..	36·6	57
	4–5	338	13·4		..	..	..	144	12·0		17·9		..	..	20·7	
	5–6	137	5·0		..	..	..	40	3·3		10·6		..	..	8·5	
	6–7	61	2·3		..	..	..	20	1·7	19	6·5	42	..	..	5·4	43
	7–8	58	2·2	13	..	..	..	20	1·7		8·6		..	..	8·0	
	8–9	83	3·2		..	..	..	..	..		15·8		..	..	..	
	over 9.	..	..		..	..	..	..	..		..		..	..	..	
Puttur Range.																
Yenmuru	2–3	..	..		..	..	..	..	..		..		..	..	..	
	3–4	2,218	49·2	79	..	..	..	1,185	59·2	59	28·3	58	..	..	42·1	42
	4–5	1,400	29·7		..	..	..	567	28·3		29·3		..	..	33·4	
	5–6	646	13·2		..	..	..	186	9·3		20·2		..	..	16·4	
	6–7	285	6·0		..	..	..	49	2·5	41	12·5		..	..	6·7	58
	7–8	126	2·2	21	..	..	..	9	0·4		7·6	42	..	..	1·5	
	8–9	22	0·4		..	..	..	..	..		1·6		..	..	..	
	over 9.	..	..		..	..	..	..	..		..		..	..	..	
Uppinangady Range.																
Mujur Reserved Forest.	2–3	1,692	14·1		..	..	..	1,219	18·7		4·9		..	..	7·7	
	3–4	4,945	41·1	84	..	..	..	2,856	43·8	63	28·3	67	..	..	35·3	43
	4–5	3,527	29·0		..	..	..	1,921	29·4		33·3		..	..	39·3	
	5–6	1,197	9·9		..	..	..	433	6·7		16·9		..	..	13·2	
	6–7	373	2·0		..	..	..	82	1·3	37	7·3		..	..	3·5	57
	7–8	241	0·3	16	..	..	..	17	0·2		7·5	33	..	..	0·9	
	8–9	35	..		..	..	..	..	..		1·2		..	..	..	
	over 9.	8	..		..	..	..	..	..		0·3		..	..	..	

Section 4.—Outline of Future Policy.

299. The following are the principal considerations which influence future management.

300. *Extraction.*—Contraction of output appears at present desirable. Return to normal conditions cannot be accurately foreseen, but the system must be susceptible to rapid expansion of output to meet increasing markets whenever demand arises, without dislocation of management. There is no present danger of cutting beyond the total possibility of the forests of the division, which have enormous potentialities for the future. Limit appears to be necessary only in the realization of certain species during the first 30 years of working owing to a certain degree of immaturity which characterizes even the most mature of our forest reserves in this district. Limitation of output is called for at the time of writing for three reasons: firstly, depressed trade conditions, which have reacted adversely on the timber market, accompanied by a fall in prices; secondly, a glut of timber in West Coast depots; thirdly, a preponderance of immature timber in the division. Eepressed conditions are further accentuated by the large quantity of timber still forthcoming from private lands. In order to cope with revived trade conditions, whenever they may become apparent, and to permit an increasing scope for extraction as demand arises, the limits of the Timber Working Circle are very loosely defined and may be added to from time to time as desired. In addition, a small range of selectiveness is allowed for in the method of felling within the annual coupes, which will allow an enhanced outturn of certain species if there is a sale for them, without dislocation of management.

301. *Development.*—(*a*) The division is run on a very narrow margin of profit, which is readily turned to a deficit in the annual budget if extensive fresh works of development are undertaken. Capital outlay at the present time must be restricted to the very minimum necessary, and expenditure on regeneration must not be excessive, even though it might be financially justifiable in the long run. Provided that the requisite annual yields continue to be forthcoming at a profit from selected blocks forming the present regeneration area, there is no object in felling elsewhere unless and until there is reliable indication of the possibility of regular working at an enhanced profit in the other blocks.

(*b*) *Reconnaissances and enumerations*—at present incomplete—in Government unreserves and waste-lands indicate that there is here a very appreciable quantity of marketable timber at present unrealized and liable to illicit removal. There would seem no reason why these supplies should remain unexploited for State benefit. It is estimated that these sources would supply the market for several years without tapping reserves at all. They are for the most part within accessible limits of working. Their removal in the immediate future would postpone the necessity for expensive capital outlay on development of reserves. Exploitation need be regulated by no considerations of sustained annual yield, and fellings would be purely for the sake of revenue without regard for regeneration. The species available include a large quantity of *Hopea parviflora,* which in reserved forests is still preponderatingly immature. Realization from unreserves of this species would moreover permit of those advance preparatory works in evergreen compartments of reserved forest selected for regular working, which are considered necessary in order to secure satisfactory conditions of regeneration prior to felling.

302. *Sylviculture.*—(*a*) Mixed irregular forests are desirable in South Kanara, and this condition tends naturally to develop in the older crops. What is chiefly desired is a greater proportion of utility species per acre, combined with an aggregation of age-classes which will permit satisfactory, but not too intensive methods of working.

(*b*) Without at present threatening the preponderance of deciduous species in the division, it is held that an increasing extent should come under evergreen crops. Reasons for this are given below :—

(1) A higher yield per acre is obtainable from evergreen forests: provided that the species grown are marketable, present crop values would be doubled or trebled.

(2) Root-systems of evergreen crops appear more readily adaptible than those of deciduous species to the general conditions of soil in South Kanara. Humus accumulation is accelerated and the soil more effectively preserved.

(3) The growth of evergreen species is observed to be more rapid, once the plants are established, than is the normal growth-increment of deciduous species. They are also generally of cleaner growth-habit. Inferior quality deciduous forests from old kumri clearings are observed in some localities to be giving place to a superior type of evergreen forest.

(4) The widespread spontaneous regeneration of species such as *Hopea parviflora* in moist deciduous and sub-evergreen localities points to a state of type-succession having been reached pre-eminently suited to such species. It is easier and cheaper usually to conform with natural processes than to work in opposition thereto.

(5) Species such as *Hopea parviflora, Dipterocarpus indicus, Artocarpus hirsuta, Mesua ferrea* and *Calophyllum tomentosum* are admirably adapted to the system contemplated, and should provide the fullest possible stocking under suitable treatment. Established groups begin to act as nuclei or propagation centres from about their 25th to 30th years.

(6) Wild animals, vermin, monkeys and other pests to young crops do not as a rule frequent true evergreen forests. (On the other hand leeches are a disadvantage.) After a full stocking is obtained, the bug-bear of dense undergrowth, so common in moist deciduous forests, is largely eliminated.

(7) Certain of the evergreen hardwoods are almost the constructional equivalents of teak, the success of plantations of which latter species has not yet been demonstrated in South Kanara. They would prove a useful alternative crop in view of the threatened glut of the less valuable deciduous timbers.

(8) Should there ever be a demand for soft-woods, evergreen species are the most readily raised and show very rapid growth.

(9) The characteristic minor produce of the division comes chiefly from the evergreen forests.

(10) The fostering of evergreen conditions should aid generally in the reduction of fire occurrence and in limiting its extent. This alone would benefit the State indirectly to very considerable degree.

303. *Regeneration.*—(*a*) Future operations in the Regeneration Area must be undertaken with the object primarily of ensuring regeneration to the full extent of the gaps created by fellings, and with the ultimate object of bringing the entire area under profitable timber species—this latter object being an ideal not likely to be reached in one rotation.

(*b*) Considerations of cheapness urge that advantage be taken of natural regeneration and advance-growth wherever possible.

(*c*) Extensive plantations under shelterwood are not contemplated, since uniformity in artificial methods of regeneration will result, as it has done in the past, in partial failures in deciduous compartments (vide paragraphs 205–207, Part I), and in others to sacrifice as well as complexity, in the removal of the overwood, which exists in all ages and conditions.

(*d*) High costs of formation and upkeep are not financially justified except with a very few high-grade timber species. In South India, clear-felling with artificial regeneration is not ordinarily financially justified with any species except teak, which for reasons already given must continue to be dealt with on an experimental basis only.

(*e*) The combination of natural and artificial methods of reproduction by an adaptation of the group-selection system appears best suited to the majority of forests to be dealt with. This will impose considerable power of discretion on the management, but the risks of failure should be reduced. It is urged that the *gross* application of any particular method or system of regeneration to South Kanara conditions is unsound practically and that the actual '*modus operandi*' must be subordinated in each circumstance to the controlling habitat conditions of the locality dealt with.

304. *Staff.*—Frequent changes of staff are inadvisable in the interests of efficient working. The argument for skilled management has greater cogency in this division than in others worked under more straightforward conditions. It would be convenient if one gazetted officer were to be engaged continuously over a period of years in the supervision of cultural operations, so that changes of personnel in District and Range charges would cause a minimum dislocation of effort.

305. *General.*—Since rigid prescriptions are not invariably applicable to all the circumstances, more especially in the tending of these forests, the system requires the management to apply its own self-corrective measures along with periodical revision and careful record of works undertaken.

It will be incumbent on the management to retain a perpetual outlook beyond local markets, which will never be able to absorb the full possibility of the forests in the division, and to concentrate on the production of those timber species which are likely to obtain the widest sale in external markets.

SECTION 5.—METHOD OF TREATMENT.

306. *Preliminary exploitation from unreserves.*—The administrative convenience to be derived from working Government unreserves and waste lands prior to further exploitation from reserves was agreed upon during conference at Ootacamund in May 1931 (vide also paragraph 301). Upon the completion of enumerations in the unreserves, a definite scheme of extraction will doubtless be formulated. At the time of writing, there would appear to be sufficient material available for the annual production of about 10,000 broad

gauge railway sleepers for the next five years, i.e., until the year 1936–37. It will be a matter for due consideration whether the unreserves should be worked also for the production of logs of all species, and to what point of exhaustion it would be practicable or politic to work them.

307. *Effect on the prescriptions of this working circle.*—However this may be, the policy of operating in unreserves, while forming no essential part of this plan, will necessarily affect the time-element in all operations which involve timber extraction and regeneration in reserved forest, and the prescriptions contained in the paragraphs which follow must remain to some extent in abeyance for a period which cannot at present be definitely stated, but which is estimated to be about five years. The general framework of the plan will remain unaltered, and tending of already partially-regenerated compartments will naturally be continued. All that can be prescribed is that the full operation of the plan for the Timber Working Circle will be brought into effect only when the present policy, which is a temporary one, is abandoned. It is to be remembered, however, that advance or preliminary works in connection with regeneration are prescribed for certain evergreen compartments which must be taken up before fellings are undertaken.

308. *General system of management.*—The system to be adopted in the management of reserved forests under this working circle does not follow strictly any of the conventional methods. It is described hereunder.

309. *A. Regeneration.*—(i) Fellings over existing groups of natural seedlings and advance growth of desirable species, with subsequent enlargement of gaps.

(ii) Liberation of all valuable species originating from natural-sown seed and root-suckers, throughout the annual coupe.

(iii) Artificial sowing or planting of shade-bearing species in patches of varying extent under shelter of the overwood, where natural regeneration is sparse and unlikely to be induced readily by further opening of the canopy.

(iv) Artificial sowings in gaps created by the fellings, where no regeneration is existent on the ground. This is known in Madras as 'gap regeneration,' and the method will be applied chiefly to the regeneration of deciduous light-demanding species and of modified light demanders.

310. *B. Felling and extraction.*—(i) The fellings will be in the nature of 'concentrated regeneration fellings' (Troup) which, while varied in their scope and intensity, are nevertheless carried out with the object of regenerating definite areas within a certain period of time.

(ii) Yearly extraction of exploitable timber is confined to annual coupes prescribed by area on the basis of their estimated volume content. These coupes are located in an area known as the 'Regeneration Area' which corresponds to a 'periodic block' under the 'Uniform System.' This 'Regeneration Area' is to be worked over and regenerated within a definite maximum period of years.

(iii) Exploitable trees on this area will be extracted in more than one operation, successive operations not differing essentially one from the other. Trees of marketable value over a specified minimum girth are felled and converted. Valueless trees are girdled or felled where required in order to admit more light to the young crop. All fellings, whether made for revenue or not, are to be chiefly in the interest of regeneration, and subject to sylvicultural expediency.

(iv) Successive fellings over the same area will be made on a prescribed felling-cycle which is adjudged to be the approximate length of time requisite to allow the next lower girth class in the overwood (after mature trees are extracted) to pass over into exploitable limits. The fellings are repeated so long as an adequate volume of mature timber is found on the ground, or until the area is satisfactorily restocked with desirable species, up to the prescribed maximum period.

(v) The regeneration period will be a long one. Reasons for this are discussed in paragraphs 316–320.

(vi) Annual coupes are re-allotted at every revision, which will be at 10-yearly intervals (vide paragraph 322). During the second felling-cycle the limits and extent of each coupe need not coincide with those of the first felling-cycle. Latitude will be allowed not only in the allocation of the coupes, but also in the volume annually cut, provided that the total prescribed volume for the 10-year period is not exceeded.

(vii) It will further be open to the revising officer to reconstitute the component parts of the regeneration area as he deems fit, at any revision (vide paragraph 322). It is probable that some compartments will become fully restocked in a comparatively short period while others will take considerably longer. Any compartment which has thus become completely regenerated might be thrown out of the regeneration area and a fresh area taken in. Any mature timber which may remain standing in an area thus thrown out can subsequently be removed by improvement fellings (vide paragraphs 427–428).

311. The system proposed is a compromise between the uniform and group methods on the one hand, and the selection and group-selection methods on the other. Thus, while the regeneration of a definite fraction of the total area is aimed at within a period of time called the 'regeneration period,' the substitution of the present irregular crops by even-aged crops is not contemplated, neither will it be possible in practice to achieve it. There will always be present on the area a considerable volume of timber of mixed species presenting an irregular, uneven-aged character, but at the end of the period, the forest should be more homogeneous in its constitution. Some degree of irregularity in the method of working is imposed by (*a*) the extremely 'patchy' nature of the crop, both in age and composition, often within a single coupe or compartment so that one portion might well be under regeneration while another is not; (*b*) variations in the proportion of utilizable material within different compartments; (*c*) varying rates of growth of different species, with correspondingly different ages of maturity; (*d*) different—and in some cases adjustable—minimum girth-limits of extraction for different species; (*e*) varying conditions governing regeneration; (*f*) varying degrees of shade-bearing capacity of different species.

312. The system approaches most closely that known as the 'Irregular Shelterwood System,' or Swiss 'Femelschlag.' The danger in this method lies chiefly in loss of control over regeneration covering large areas. This, however, is more apparent than real. Large areas, and somewhat diffuse and varied methods of regeneration, cannot be avoided under any system which could be applied to these forests. Comment has already been made (vide paragraphs 205–207) on the threatened loss of control liable with extensive plantations under shelterwood. Even for equal-aged shade-bearing crops no rigid prescriptions can be laid down or applied with any degree of exactitude (vide paragraph 220). Uniformity in methods of regeneration in the past has led to the writing off of considerable sums on areas which have failed owing to unsuitable conditions. Skilled individual sylvicultural attention thus becomes necessary at every stage. A fairly intimate mixture of species, combined with a considerable range of age-classes is not only unavoidable in the majority of cases, but on the whole is advisable in South Kanara in order to suppress weed-growth. Loss of control has in most instances during the past decade been experienced as the result of prolific weed-growth having obscured regeneration after clearings have been made in the overwood. A modified application of the Irregular Shelterwood System will tend to minimize this nuisance while retaining the fertility of the soil. Concentration on the regeneration area for a lengthy period, combined with the application of certain safeguards (prescribed later), will ensure that no part of a compartment under regeneration is relinquished until it contains a satisfactory crop of tree-growth wherever trees will grow. Time is moreover saved in securing established regeneration, a fact of great importance when dealing with evergreen crops. Further advantages of the system are that sacrifices in the overwood are reduced to a minimum, while accrual of increment is assisted in all stems approaching maturity. Chosen stems, e.g., of *Dalbergia latifolia, Terminalia tomentosa, Artocarpus hirsuta,* etc., may also be retained indefinitely if desired so that enhanced increment is obtained on those timbers which have special markets in large sizes.

313. *Rotation.*—With present lack of growth data no definite rotation conforming with exploitable age can be fixed. Under the present system of management, it is unnecessary to do so. Instead, a nominal rotation, being merely an approximate average age for trees felled, is adopted. This is postulated at ninety years. Such a rotation might be slightly high for *Xylia xylocarpa,* while for special purposes other species, such as *Dalbergia latifolia* and probably some evergreens, might well be left to grow for a longer period. Ring countings appear to indicate that most deciduous trees put on an average annual increment in girth of from 0·75 to 0·8 inch—vide paragraph 269 of Part I. Evergreen species in favourable situations appear to add 1 inch annually to their girth on the average—vide paragraph 264. At the age of ninety years, *Terminalia paniculata, Terminalia tomentosa, Lagerstrœmia lancœlata, Adina cordifolia* and *Albizzia Lebbek* may be expected to have girths approximately between 6′ 0″ and 7′ 6″; *Tectona grandis, Dalbergia latifolia* and *Pterocarpus Marsupium* between 5′ 6″ and 6′ 6″; *Xylia xylocarpa* between 4′ 9″ and 5′ 6″; *Hopea parviflora* and *Artocarpus hirsuta* between 7′ 6″ and 8′ 6″. In natural-grown woods there are frequent defects in the larger sizes especially in fire-burnt areas, which decrease their economic value, but forests properly grown and protected from the beginning should largely escape such degrade.

Hopea parviflora and *Artocarpus hirsuta* are apt also to suffer from insect and fungoid infection. Nevertheless measurements indicate that *Hopea parviflora* remains capable of adding very vigorous increment up to a considerable age. With properly regulated thinnings, aeration in the lower storey and prompt removal of all possible sources of infection during fellings and subsidiary operations, it is reasonable to think that evergreen species may remain healthy until well beyond the girths attained at the age of ninety years.

314. *Size of the regeneration area.*—The area now proposed for felling and regeneration covers 10,230 acres, which is only approximately one-eighth of the potential timber bearing forest of the division ; or if the ghat regions are entirely excluded one-sixth of the plains and foothills forest. There is manifestly considerable scope for future expansion as markets develop, but we cannot reasonably expect to work more than this area within a measurable period without risking an undue glut of timber at the depots.

315. *Exploitable girth-limits.*—The minimum girths at which trees are to be felled are fixed for the several species with regard both for the requirements of management and of local markets. The dimensions are given hereunder :—

For *Hopea parviflora*, *Artocarpus hirsuta* and all evergreen species.	6 feet at breast-height or above buttress.
For *Terminalia paniculata*	6 feet at breast-height or above buttress.
For *Terminalia tomentosa*, *Lagerstroemia lanceolata*, *Tectona grandis*, *Dalbergia latifolia*, *Albizzia* species and all species not otherwise specified.	5 feet at breast-height or above buttress.
For *Xylia xylocarpa*	4 feet at breast-height or above buttress.

The above girths generally represent the minimum sizes which can be logged or converted profitably, and are thought to be conformable on the whole with a rotation of ninety years, being approximately the sizes which would be attained at the end of that period. Owing to the small demand for *Terminalia paniculata* except as first-class logs, the limit has been fixed at 6 feet at present, but there is no theoretical objection to reducing this figure when material can be sold, since this species occupies a high proportion of the crop in deciduous forests, and its rate of growth is in no way inferior to that of other deciduous species. *Xylia xylocarpa* is at present permitted to be felled for economic reasons, at a girth which is probably a trifle lower than that which would be attained at the end of the rotation, it being generally found that the younger timber has less refractory qualities when converted than that from trees of larger girths. At the same time a girth of 4′ 6″ is theoretically a more desirable one than 4 feet and this might be reconsidered at the next revision. For first-quality timber crops, the above limits are on the low side, more especially for the evergreen species. This is intentionally so. At the present time, as pointed out in the foregoing paragraph, the stands are all predominantly immature, so that both for economic and theoretical reasons it is advisable to fell to rather lower girths than might be otherwise desirable. It is emphasized however, that the system of management contemplates the retention of particularly sound, vigorous stems of desirable species wherever it is possible to secure timber of superior dimensions which will sell at enhanced prices. There is accordingly no obligation on the management to fell superior stems merely on account of their being above so-called exploitable limits. This is a matter for the discretion of the District Forest Officer.

316. *Regeneration period.*—Under normal circumstances, a period of thirty years, equivalent to two felling cycles, should be sufficient to permit of regeneration, by whatever means obtained, to become established. Our experience in certain types of forest is not quite adequate to warrant assertion to this effect in all cases, but any qualification which may be necessary is due not to doubts as to whether tree species will grow but rather as to the correct method of treatment to accord in order to prevent occupation of the ground by fast-growing adventitious species, and the speed with which canopy must accordingly be removed. Such doubtful cases are few however.

317. The simple adoption of the above premise unfortunately does not fully accommodate all the circumstances attaching to the present regeneration area. These circumstances relate not so much to the practicability of achieving established regeneration in the compartments contemplated for working, but rather to the actual constitution of the present crop which is to be exploited, and the wide divergencies which exist between different classes of crops now unavoidably lumped together for regeneration. It is anticipated that these circumstances will not be so marked in future regeneration areas, but for the present they must be allowed for.

318. The several blocks which now comprise the Regeneration Area fall into three distinct categories. These are—

(i) Blocks felled prior to the inception of the working plan, which contain regeneration partly, but not wholly, established. The following blocks come into this class :—

(*a*) Jalsur East Reserved Forest—natural regeneration area—felled 1921–1923 ;

(*b*) Nalkur Reserved Forest, compartment 1—natural regeneration area—felled 1925–1930 ;

(*c*) Aletti West Reserved Forest—Devakaje slopes—natural regeneration area—felled 1928–1930 ;

(*d*) Aletti East Reserved Forest—Kurekadu and Chonapadibetta slopes—advance-growth present—felled 1930–1931 (Chonapadibetta partly felled only) ;
(*e*) Sampaje Reserved Forest compartment—felled 1928–1929 ;
(*f*) Mujur Reserved Forest coupes (i) and (ii) (old series)—felled 1929–1931 ;

Areas (*a*) to (*d*) are natural Hopea regions which originally contained mature and over-mature Hopea for the most part. Regeneration is, in various stages, being most advanced in the older coupes. Areas (*e*) and (*f*) are deciduous regions, the regeneration therein being not so advanced as among the evergreens. The total area of these blocks is 1,548 acres.

(ii) Blocks not yet felled, but wherein preparatory operations have already been undertaken to assist natural regeneration and advance-growth. These are the moist-deciduous and sub-evergreen crops in Nalkur compartment 2, containing Hopea, on an area of 496 acres.

(iii) Blocks not yet felled, and in which preparatory operations to assist natural reproduction have not been undertaken. Their total area is 9,733 acres. Blocks in category (i) must of necessity be retained for the immediate future in the regeneration area in order to ensure that regeneration already obtained is tended until thoroughly established. In the older coupes of Jalsur East and Nalkur blocks, this should be satisfactorily achieved by the time this plan is revised. A point of importance is that these coupes contained originally a mature and overmature stand which has now been removed, and the crop remaining is unlikely to provide any appreciable material for the axe within the next two or three felling-cycles.

319. Blocks in category (iii) are however, still preponderatingly immature. That is to say, that while the exigencies of the market entail that the exploitable material therein be felled and removed, the bulk of exploitable species in the crop will continue progressively to attain maturity during the whole of the next forty-five years. This circumstance is particularly marked in the evergreen forests containing Hopea, and the blocks now included in the Regeneration Area are almost the sole remaining accessible Hopea areas in the district. The reader is referred to paragraph 298 for a detailed analysis of the crop. It will be seen that even with the low girth-limit of 6 feet for Hopea the percentage of exploitable stems lies between 7 per cent and 37 per cent of the total number above 3 feet in girth. For a continued supply of Hopea after the completion of the second felling cycle, there may be a choice of two courses, viz., (i) to tap other areas, now inaccessible, and raise the minimum exploitable girth-limits for Hopea (which, if possible, is desirable), or (ii) to continue tapping the present blocks for a third felling cycle of fifteen years, on the present prescribed limits of girth. A long regeneration period is quite in conformity with the Irregular Shelterwood System and is in fact desirable in these mixed forests in order to secure the maximum quantity of desirable regeneration at a minimum cost, and with small recourse to artificial methods of regeneration.

320. As it would be rash to rely too much upon the first assumption in the foregoing paragraph being found practicable, it is provided in this plan that blocks in the present regeneration area may, for the purpose of a sustained outturn of certain species or for any similar purpose of administrative convenience, be retained for regeneration over a period of three felling-cycles, or a total of 45 years, by which time there is every certitude that pole crops now distributed throughout the division will be at the point of maturity.

321. The blocks most likely to be retained for the maximum period are as follows :—

Puttur felling-series ' A '.—

Nalkur Reserved Forest Coupes i, iii, iv, v, vi, vii.
Aranthakallu Reserved Forest—Coupes viii, ix, x.

Puttur felling-series ' B '.—

Bantamale Reserved Forest—Coupes i, ii, iii, iv, v, vii-x.
Devachalla Reserved Forest—Coupe vi.

322. *Revision and reconstitution of the Regeneration Area.*—It will be evident from the foregoing paragraph that the periods actually requisite for the successful regeneration of the several compartments which have to be dealt with will differ. It is accordingly provided that the Regeneration Area will be liable to revision and reconstitution at 10-yearly intervals. This must be done by the Working Plans Circle, and will coincide with the periodical revision of the plan in its entirety. At each revision, those blocks which have been adequately exploited and regenerated shall be thrown out from the regeneration area, and other blocks included in their stead. The size of the regeneration area may moreover be enlarged, if desirable, but not beyond a maximum equal to one-third of the productive area of the total accessible timber-bearing forests of the division, at the time of revision. All such extensions of the size of the area to be regenerated must be contingent upon the ability of the staff to deal with enhanced work, and upon powers of market absorption.

323. In the management maps prepared with this plan, no periodic blocks apart from the Regeneration Area have been defined. Instead, areas suggested for future working have been indicated in red. The suggested blocks fall into two classes, which are given below, together with their extent in acres :—

(*a*) Accessible forests which are expected to come to maturity by 1962, 14,502 acres.

(*b*) Forests at present partly or wholly inaccessible for profitable working, but which contain good timber crops which may in future prove susceptible to development and economical extraction, 18,221 acres.

These two classes outside the present Regeneration Area will require visiting and properly assessing by future revising officers.

324. *Future transfer of areas now in the Protection Working Circle.*—Wholly apart from the accessible timber areas already defined on the management maps there exist at the present time accessible forests too immature or too poorly stocked to merit working for another 50 or 60 years. These are of very large extent. They are not now included within the Timber Working Circle, since there is no point in selecting certain areas in preference to others at this stage, and they are accordingly put in the Protection Working Circle. In due course, as they appreciate in quality and age, selection will be made from among them of the most suitable tracts, which will in turn be shown in the Timber Working Circle as "approaching maturity," and finally included in the Regeneration Area.

325. *Limits of the Timber Working Circle to be based on the Regeneration Area.*—The Timber Working Circle will accordingly comprise more and more forest in the course of time. Its total productive extent at any particular time will be limited to thrice the area of the Regeneration Area, the size of which is determined at each revision according to the anticipated annual yield therefrom, based on expectation of market requirements during the following ten years.

326. *Calculation of the Possibility.*—When the total extent and limits of the Timber Working Circle can be defined with greater accuracy, in other words when the total growing-stock which is to be felled during the rotation can be even approximately assessed and analysed, the possibility might be conveniently calculated by one of the volume methods, such as that based on diameter classes.

327. The Mangalore forests manifestly will not become susceptible to a rigid framework of management for many years to come, and an opportunist policy which will follow the progressive development of the division is in the meantime essential. We are quite assured, on the basis of area alone, that there can be no danger of felling beyond the total possibility of the timber-bearing forests of the division for many years to come. In order to illustrate this point, a first and very crude approximation of the total possibility of the timber-bearing forests may be arrived at in the following manner :—

It will be assumed that the average acre, young or old, of all the several types of forest met with, holds 8 trees of useful species which when mature could be removed at a profit ; also let it be assumed that each of these trees at maturity will yield 35 cubic feet of merchantable timber in the log (see volume curves, Chapter VI, Part I). Then the yield to be expected from the average acre will be 35 × 8 cubic feet, i.e., 280 cubic feet. This figure as a matter of fact, is very approximately that now removed in cubic feet per acre from current coupes worked on a *selection* basis, such coupes being not wholly mature, yet representing fairly good timbered tracts. It may therefore be considered to be a very conservative estimate for the average *mature* acre. Upon the further assumption that it would require 90 years to produce the mature tree, the average annual *utilizable* increment would be in the neighbourhood of 3 cubic feet per acre. Again, excluding the ghat forests, a conservative estimate of the extent of timber-bearing forest in the division is 70,000 acres. (This figure also does not include reserves which are now classified under this working plan as "plantations" and which are separately dealt with in Chapter III.) The possibility of the plains and foothills jungles in this division should therefore be *not less than* 2,10,000 cubic feet per annum. Present markets can absorb not more than 80,000 cubic feet per annum, so that little more than one-third of the total possibility is in fact being harvested. This, however, if the undoubted immaturity of the forests as a whole is taken into account, is not an objectionable fact. The above figure might with safety be doubled were it possible to market such species as *Terminalia paniculata*, *Adina cordifolia*, *Albizzia* species, *Dipterocarpus indicus*, *Eugenia Gardneri*, *Calophyllum tomentosum*, *Dichopsis elliptica*, and some of the many softwoods which abound, at profitable prices.

328. The above method of calculating the possibility is crude and of no immediate value. In the unique circumstances of this division, none but the most simple and adaptable of methods need be applied for the immediate future. This is found in Judeich's "Bestandswirtschaft," a method whereby no attempt is made to regulate the yield for more than a decade or two in advance, it being held that no method of determining the size of the cut over a lengthy period is ever accurate without very frequent revisions. The annual coupe is therefore prescribed entirely to suit the exigencies of the situation according to administrative, sylvicultural and economic requirements. Frequent revisions are however essential

in order to safeguard the continuity of the forests' productiveness. Approach towards normality is aimed at by a progressive regulation of the distribution of age-classes in the forests worked over, this being done without sacrifice to rigidity.

329. Reference to the table of basal areas and numbers of trees represented in each girth-class (vide paragraph 298) shows that the basal areas occupied by each girth-class are not widely variant one from the other, while numbers of stems progressively increase from the higher to the lower classes. From observation there would appear however to be a marked deficiency in the very youngest classes of seedlings and saplings in most compartments. The total number of trees of utilizable species on the Regeneration Area, of and above 3 feet in girth, is about 97,400, which number, after applying a reduction factor of 0·8 (an arbitrary figure, which seems a reasonable one to adopt) for subsequent mortality during the period, reduces to 77,900. During the first felling-cycle of 15 years, which will commence in (about) the year 1937 (vide paragraph 306), it is proposed to remove approximately 26,200 trees, i.e., about 33 per cent of the total number. We may confidently expect that of the remaining 51,700 trees, at least 22,800 will again have come to maturity by the time of the second cut, and will accordingly be harvested during the second felling-cycle, commencing about 1952 and finishing in 1966. At the conclusion of the second felling-cycle, two-thirds at least of the regeneration area will have been regenerated with young trees 1-30 years in age ; in addition there should still remain on the area some 30,000 trees of exploitable species at the point of maturity plus a large number of unmarketable trees and poles.

330. Thus, while not destroying the essential irregular character of the vegetation in the blocks to be regenerated, the age-classes should be more compactly distributed, and at the same time provision will have been made for a far greater proportion of utilizable species for the future.

331. The total calculated growing stock above present exploitable limits (vide paragraph 334) is at present 20,57,000 cubic feet of standing timber. Since the first felling-cycle is anticipated to commence only after unreserves are abandoned, i.e., in about the year 1937, increment will have accrued before the end of the first felling-cycle during a period of six years plus 15 years, a total of 21 years. (The above date is necessarily tentative, and not quite definite.) Increment of 1 per cent for half this time, i.e., for 10½ years is therefore to be added to the above figure. The total net yield from the present Regeneration Area during the period 1936–52 is accordingly derived as follows :—

	C.FT.
Volume of present growing-stock (standing timber) ..	2,057,000
Estimated net yield, after applying reduction factor of 0·6	1,234,000
Add 1 per cent for 10½ years	18,500
Total net yield during first felling-cycle	1,252,500
Volume of annual cut	83,500

This figure is obtained without including timbers of doubtful saleable value, previously referred to in paragraph 327. In localities where these species are commonly found, they are included supplementarily in the volume estimates, so that their approximate quantities are known (vide tabulated statements of volume estimates). If there is demand for *Terminalia paniculata* in logs below 6 feet girth, the outturn may be further enhanced by reducing the present minimum girth to 5′ 6″ or even lower. At the same time, species such as *Terminalia tomentosa* have been included in the estimates of the growing-stock available in such localities as Nalkur Reserved Forest, whence at the time of writing there is no profit obtainable by extraction of these species ; yet, inasmuch as they have been successfully exploited in the past from this region, they are included in the expectation that they may again become so in the future should prices revive. Of greater importance than the volume of the annual cut is the fact that at least 12,52,000 cubic feet of logs should be removed from the *present* Regeneration Area during the first felling-cycle.

332. *Regulation of the annual yield.*—Coupes are defined by area on the basis of their estimated volume contents after proportional enumerations (vide paragraph 334).

333. *Felling cycle.*—A felling-cycle of 15 years has been adopted, this period being one-sixth of the entire rotation and a sub-multiple of the regeneration period. It is expected that the whole of the present regeneration area will have been worked over once during the first cycle A cycle of 15 years is thought to be a suitable and necessary interval between two successive fellings on the same area in order to permit the timber in the girth-class next below exploitable limits to come to maturity.

334. *Felling series.*—Four felling series have been prescribed. These are named according to the territorial ranges in which they are allocated. Puttur Range has two felling series, named respectively Puttur Felling Series ' A ' and Puttur Felling Series ' B.' A table is set forth below showing the distribution of coupes within each series, together with their respective areas and estimated volume contents.

Timber Working Circle.

Yield Statement.

Net expected volume in cubic feet after conversion.

Locality	Coupe.	Area in acres.	Teak.	Terminalia tomentosa.	Terminalia paniculata.	Lagerstroemia lanceolata.	Xylia xylocarpa.	Dalbergia latifolia.	Artocarpus hirsuta	Hopea parviflora.	Mesua ferrea.	Dichopsis elliptica.	Cedrela toona.	Disoxylum malabaricum.	Grand total.
						Kasaragod Felling Series.									
Sampaje Reserved Forest—															
Bantwadi	I	82	..	9,003	3,443	803	6,710	69	..	..	..	..	..	..	20,028
Do.	II	102	179	6,933	6,781	724	13,402	44	..	..	..	..	..	..	28,063
Baile	III	50	5,569	629	4,815	2,871	7,983	273	..	..	..	..	..	..	22,140
Do.	IV	73	5,370	1,768	2,361	3,273	7,135	309	..	..	..	..	..	..	20,216
Kanalithodu	V	48	..	4,102	2,894	261	6,231	183	..	..	..	..	..	..	13,671
Do.	VI	48	..	6,816	2,708	685	9,102	116	..	..	..	..	..	..	19,427
Do.	VII	46	..	7,817	3,087	1,447	8,980	583	..	..	..	..	..	..	21,914
Do.	VIII	46	76	8,457	2,403	1,181	3,842	107	..	..	..	..	..	..	16,066
Do.	IX	52	..	10,431	3,789	663	8,798	43	..	..	..	..	..	..	23,724
Do.	X	52	..	7,817	3,087	1,447	8,980	583	..	..	..	..	..	..	21,914
Total ..			**11,194**	**63,773**	**35,368**	**13,355**	**81,163**	**2,310**	..	..	..	..	..	..	**207,163**
						Puttur Felling Series 'A.'									
Jalsur Reserved Forest ..	II	189	..	12,639	5,446	809	18,000	76	..	684	..	..	..	..	37,654
Nalkur Reserved Forest ..	III	182	..	9,348	12,450	638	12,766	..	4,407	2,086	..	..	..	..	41,695
Do. ..	IV	190	..	2,683	15,785	2,467	12,984	..	3,739	3,960	..	..	..	..	41,618
Do. ..	V	206	..	11,650	5,720	252	806	..	4,012	13,875	..	..	..	..	36,315
Do. ..	VI	168	..	13,857	5,064	471	1,019	..	13,807	21,471	..	..	..	..	55,689
Do. ..	VII	210	..	14,377	7,909	2,490	5,476	..	20,342	28,828	..	..	..	..	79,422
Aranthakallu Reserved Forest	VIII	101	..	3,904	1,492	389	1,806	413	807	5,809	..	..	..	..	14,620
Do.	IX	84	..	1,435	13,444	1,176	14,043	..	3,370	7,492	..	..	..	..	40,960
Do.	X	86	..	4,429	7,157	1,824	13,247	..	4,891	9,761	..	..	..	..	41,309
Total ..			..	**74,322**	**74,467**	**10,516**	**80,147**	**489**	**55,375**	**93,966**	..	..	..	..	**389,282**
						Puttur Felling Series 'B.'									
Bantamale Reserved Forest	I	97	..	..	2,451	102	..	..	414	6,673	..	432	..	..	10,072
Do. ..	II	68	..	..	1,365	..	..	..	495	7,483	530	..	..	..	9,873
Do. ..	III	92	..	..	2,122	..	..	..	1,018	12,171	2,566	..	..	..	17,877
Do. ..	IV	90	..	..	488	..	..	..	1,050	9,402	468	..	..	..	11,408
Do. ..	V	96	..	..	6,944	..	..	..	1,962	8,407	..	..	..	..	17,313
Devachalla Reserved Forest	VI	79	..	..	4,336	7,401	..	..	202	6,888	..	..	485	..	19,312
Bantamale Reserved Forest.	VII	108	..	..	2,493	810	..	..	..	3,760	3,611	803	..	..	11,477
Do. ..	VIII	99	..	..	..	..	..	..	553	..	15,619	6,750	..	3,040	25,962
Do. ..	IX	102	..	..	835	473	..	..	..	1,466	14,621	5,632	..	1,035	24,062
Do. ..	X	107	..	..	267	634	7,175	..	8,437	..	5,266	3,801	2,410	..	27,990
Total ..			..	..	**21,301**	**9,420**	**7,175**	..	**14,131**	**56,250**	**42,681**	**17,418**	**2,895**	**4,075**	**175,346**
						Uppinangady Felling Series.									
Mujur Reserved Forest ..	I	83	..	2,693	1,943	2,735	14,953	48	169	..	..	..	..	..	22,541
Do. ..	II	72	..	3,936	3,192	1,936	9,219	..	341	..	..	..	..	..	18,624
Do. ..	III	96	..	5,082	1,719	2,483	12,008	324	1,419	..	..	..	..	..	23,035
Do. ..	IV	80	..	9,800	4,546	2,352	11,263	..	288	..	..	..	..	..	28,249
Do. ..	V	88	..	9,022	8,952	742	23,033	..	..	..	..	..	..	..	41,749
Do. ..	VI	76	..	4,913	3,486	1,506	6,987	..	..	..	..	..	..	..	16,892
Do. ..	VII	68	..	2,078	3,715	192	5,563	..	..	..	..	..	..	..	11,548
Do. ..	VIII	95	..	5,740	3,546	2,291	9,960	142	..	..	..	..	..	..	21,679
Do. ..	IX	103	..	5,944	947	1,303	6,033	90	816	..	..	..	..	..	15,133
Do. ..	X	104	..	7,484	3,130	2,632	9,128	76	552	..	..	..	..	..	23,002
Total ..			..	**56,692**	**35,176**	**18,172**	**108,147**	**680**	**3,585**	..	..	..	..	..	**222,452**

SECTION 6.—FELLINGS AND EXTRACTION.

335. *Survey and demarcation of coupes.*—All coupes shall be surveyed and demarcated before the end of December of the year before felling is normally due.

336. *Marking for fellings.*—(i) Marking for fellings will be completed by the end of February of the year prior to felling. Marking will be restricted to marketable species and grades only. These will be defined in the felling specification and communicated to the marking officer beforehand. Trees selected for felling will be blazed at breast height and serially numbered with tar. The girth at breast height, the species, and length of workable bole will be entered in "Form 3" of the Madras Forest Code. The volume tables given in Chapter VI of Part I are not expected to be yet of sufficient accuracy to warrant the venture of their use, but it is expected they will be improved in due time. Dead or wind-fallen trees if of value will be also marked and recorded.

337. (ii) Prior to commencement of felling the District Forest Officer or a gazetted assistant shall go through the entire coupe and make a sylvicultural re-marking. He will see that the marking is moderately evenly distributed and that gaps of more than 12 yards diameter are not normally created, unless masked by subsidiary tree-growth. All trees passed by the checking officer will be given a second blaze at the foot of the tree, and the serial number will also be recorded over the blaze. Trees which he decides to retain on the ground instead of felling will be struck off the marking register. No definite rule can be laid down regarding the intensity of felling, which must be a matter for the discretion of the responsible officer. This will depend upon the method of regeneration proposed, on the existence or otherwise of desirable advance-growth already on the area, and on the type of underwood and ground-flora. The following brief instructions are intended to form a guide :—

(*a*) The prior existence of vigorous advance-growth of desirable species in an area chosen for natural regeneration may permit of the area being opened up with some confidence. Where however, there is a danger of suppression by fast-growing valueless species, a gradual and conservative opening is preferable.

(*b*) The shade canopy should not be too drastically opened over thorny or scandent climbers, *Strobilantes*, Lantana or Bamboo regeneration.

(*c*) Where controlled burning of slash and undergrowth is contemplated in order to stimulate germination of seed or root-suckers, the opening in canopy can be rather freer than where no burn is contemplated.

(*d*) If regeneration by evergreen species is contemplated, felling in the upper storey should have definite relationship with the distribution of underwood and middle storey trees, so that undue exposure of the soil does not result.

(*e*) Aspect and quality of soil must have due consideration. This needs no elaboration, and further instructions are given in paragraph 419 relating to subsidiary operations.

(*f*) In deciding which of a group of trees are to be retained for protective purposes, those of crooked or malformed stems and doubtful soundness would normally be kept ; but if the choice is between sound exploitable stems, those which promise to put on the most vigorous increment during the felling-cycle should be retained.

The sylvicultural marking shall be made before the majority of deciduous trees regain their new foliage.

During the course of this operation the District Forest Officer shall check the accuracy of the original enumeration as regards measurements, species, etc., over not less than 10 per cent of the area.

338. *Extraction plan.*—After final sylvicultural marking has been completed, the District Forest Officer shall prepare a statement showing the expected outturn from the coupe, the lay-out of extraction roads within the coupe, and sites for forest depots. Sheds for felling coolies and sawyers may require to be built, and their position should be decided upon. A sketch-map of the area and estimate of costs for sanction will accompany the statement submitted as usual to the Conservator.

339. *Felling and logging.*—The existing practice of "advance fellings" (vide paragraph 111) will need to be continued in all three ranges in the principal felling locations. Fellings of an advance nature will be started to suit administrative convenience from November onwards but in any case not later than the beginning of January. Normal fellings will commence as early as possible, continuing during June and July, and will be arranged so that extraction is completed by the end of September. Trees shall be felled so as to do as little damage as possible to standing timber and existing regeneration. Should there be pre-existing artificial regeneration on the site, seedlings or saplings likely to be

damaged during felling and extraction should be marked by stout pegs beforehand. The debris should afterwards be removed from around the plants. Ordinary rules of felling, i.e., the crowns uphill and away from the direction of dragging should be followed. Logging and dressing of trees will be done at stump-site immediately after felling. All cross-cutting shall be done with saws. If raft-holes are made, they shall be so cut as to avoid heartwood. The initial letter in use for each species and the serial numbers should be deeply cut on all logs going to coastal depots, as after immersion in water for some period identification at depot is sometimes difficult. Mid-girths of logs will be measured after complete removal of bark in the centre of the log. In the case of *Dalbergia latifolia*, girth will be measured under sapwood. Irregularly shaped and buttressed logs, except of *Xylia*, Hopea and other species to be sawn into sleepers and scantlings shall be squared and dressed, but to the minimum extent necessary. Form 3 shall be posted immediately after logging.

340. *Dragging and extraction.*—Drag-paths should be fully thought out and aligned with care by the Range Officer before works are commenced. Uphill dragging is to be avoided. Gradients of dragpaths shall not ordinarily be greater than 1 in 5. On steep slopes sawing for conversion must be done at stump-site, unless it is possible at small expense to slide the logs on to an aligned drag-path along a contour. A powerful elephant is capable of shoving logs lengthwise down a slope, but there are obvious limits to the feasibility of this method, which should be adopted only at the discretion of the District Forest Officer, having regard to the nature of the task and the elephants available. Dragging in the forest will be by choker and cable slings. Large logs should be given a boat-shaped end in order to enable them to ride easily over minor obstacles. All elephant dragging should cease before March 31st. The use of buffaloes is not contemplated for major fellings, but they may be employed, in case of necessity, for subsidiary fellings and the extraction of small logs. All tops, crown-wood and felling refuse shall be left lying on the ground unless convertible at a profit. The decay of this material is usually rapid and is largely instrumental in enriching soil humus and in increasing moisture content of the soil. Removal by local inhabitants is prohibited. Temporary cart-tracks will be used to reduce and economise elephant power within the coupe. These should not normally involve heavy earthwork or blasting. They should be laid out with reference to convenient extension into future coupes. Cart-tracks should be widened at loading termini in order to allow ample room for carts to manœuvre without overcrowding and confusion.

341. *Carting.*—Necessary arrangements must be made to keep transport well in pace with fellings from the start. Carting must remain dependant to some extent upon the seasonal limitations of main extraction routes. The dry-weather season from December to May should therefore be utilized to the maximum, and June carting, where necessary, confined to main, all-weather roads.

342. *Rafting.*—All logs to be transported by river should be dragged to the river-bank before heavy rains commence, ready for rafting immediately after heavy floods have subsided. Logs shall be rafted by means of bamboos to log depots. This work will normally be done on contract. Bamboos and cordage will be collected by the contractor at his own expense, but free of seigniorage, and after reaching the depot will become his own property. The usual rates of $1\frac{1}{2}$ to $1\frac{3}{4}$ bamboos per cubic foot of timber to be rafted will be allowed ; in case of a shortage of bamboos, trees may be girdled a year in advance of felling, and the allowance reduced to about $\frac{1}{2}$ bamboo per cubic foot, or the minimum found necessary by experiment.

343. *Sawing.*—Logs intended for sawing into sleepers and scantlings shall be sawn "*in situ*" and where dragging becomes impossible, at stump site on scaffolding. Difficulties are anticipated to commence with in persuading sawyers to work at stump site on steep hill slopes and in leech-infected jungle, but these must be overcome. Logs will be cross-cut into suitable lengths to avoid wastage, i.e., into 9 feet, 12 feet, 15 feet, and 18 feet lengths, plus an extra 6 inches for every sleeper intended to be cut from the log, in order to allow for possible subsequent splits during or after conversion. These extra lengths will be cut off at depots before sleeper passing examination and clamping. Effort shall be made to cut as many broad-gauge sleepers as possible and metre-gauge shall only be cut when the available length of log does not permit of the former being cut. Logs shall be originally cross-cut with this in view to as long lengths as possible ; cross-cutting to sleeper length while sawing is actually in progress will not be permitted. In sawing scantlings it should also be remembered that the longer lengths are most in demand and fetch better prices. No scantling will be less than 6 feet in length. Attention must be paid to the grading rules set forth in the Madras Forest Pocket Book, both in the case of sleepers and scantlings. Many rejections of sleepers are on account of undersize. This favourite practice on the part of sawyers to cut to short measurement should be carefully watched in the forest and before passing sleepers for coastal depots. Some rejections appear also to be due to attempts to

cut two metre-gauge sleepers from a single section, instead of one broad gauge. In the sawing of planks, the broadest sizes possible shall be cut. Green conversion is desirable with all species especially in the case of refractory timbers, such as *Xylia,* and logs should not be allowed to lie in the forest for any lengthy period.

344 *Stacking.*—Stacking of sleepers, planks and scantlings must be given proper supervision. A dry level site suitably drained must be chosen under cover of standing trees. A rough shed for storing the sawn material will be constructed, which should be well roofed to protect against sun and rain. The ends of sleepers and scantlings shall be protected by piling porotes and sawn refuse against them at an angle so as not to obstruct air circulation. The timber shall be stacked on kalangis well bedded on levelled soil, and in accordance with the instructions issued by the Forest Utilization Officer, as well as those provided in the Madras Forest Pocket Book, Chapter IV. The best method of piling sleepers for seasoning is to have one end of each layer of sleepers resting on the layer below, and the other end raised on a sleeper lying on its side. The top layer should be on a slant to allow of rain water running off readily (also vide paragraph 655).

Section 7.—Regeneration of the Annual Coupe.

345. This section, which is a formidable one, deals with various measures, both prescribed and suggested, for the regeneration of the annual coupe. These may be best summarised collectively under the title of " The Method of Varied Treatment." The measures called for will vary from coupe to coupe. They are described in the paragraphs which follow under separate headings, viz.—

A General rules common for all compartments.

B Rules for the regeneration of deciduous forests.

C Rules for the regeneration of *Hopea parviflora* and other evergreen species, under the following sub-titles :—

(i) General note on the conditions requisite for the raising of *Hopea parviflora* ;
(ii) Artificial reproduction of *Hopea parviflora* ;
(iii) Natural regeneration of *Hopea parviflora* and other evergreen species.

D Regeneration in gaps. These rules are subdivided as follows :—

(i) General rules ;
(ii) Rules for artificial regeneration of gaps with deciduous species ;
(iii) Rules for the artificial regeneration of gaps with evergreen and modified light-demanding species.

E Experiments in regeneration.

It is not to be thought that all these various measures will be applied in a single coupe. In Kasaragod Felling Series, rules under heads B and D (ii) will be chiefly in use ; in Uppinangady Felling Series, rules under heads B, C (ii), D (ii) and D (iii) will be applied ; while both the Puttur Felling Series, being of a predominantly evergreen or moist deciduous character, will require the application of rules C (ii), C (iii) and D (iii). These rules are necessarily complicated owing to the very wide range of conditions met with ; even in deciduous forests the multiplicity of conditions bring constant perplexities in practice. This being so, the working plan can only deal with these in a broad and often tentative manner, which should not tie the hands of the management too closely in their practical treatment of any particular problem. The ideal may frequently have to be sacrificed to the exigencies of management, more particularly to the limits of executive capacity of the staff. One of the difficulties inherent in the treatment of these forests is the necessity for frequent return to the same coupe, both before and after felling, if regeneration is to be realised successfully. This can only be reduced to a minimum by very careful assessment of each type of locality before felling and a correspondingly cautious but correct and intensive application of sylvicultural principles during and immediately after felling. If this is done, it is anticipated that subsequent treatment need not be prolonged. In order to prevent loss of control in the years subsequent to felling, one of the most important prescriptions provided in the tabular statement of operations, is the necessity for a periodical detailed inspection of certain coupes, five years after felling, by the District Forest Officer, who should then take full responsibility for subsequent treatment of those coupes, until the plan is revised. For this reason, no definite procedure is laid down in the tabular statement of operations after such inspection is prescribed, it being felt that rigid rules would encumber rather than assist the management. For an analysis of the areas involved annually by the following prescriptions, vide paragraphs 431 and 432.

A. General rules common for all compartments.

346. The following general principles, common for all compartments within the regeneration area, are laid down :—

(1) The primary object of all regeneration fellings and subsidiary operations is to obtain a satisfactory stocking of desirable timber species in each coupe felled over, within the prescribed period.

(2) During the first felling-cycle, established regeneration over one-third of the total area of each coupe shall be aimed at. This does not mean that works should be confined necessarily to one locality or single portion of a coupe.

(3) A locality cannot be regarded as satisfactorily regenerated unless it possesses at the close of the period a minimum of 360 seedlings, saplings and young poles of marketable species per acre irrespective of other growth. In practice this means that not less than this number of seedlings and saplings should be sought out, or their growth implemented on the ground chosen for regeneration, during each felling cycle.

(4) All gaps created by the fellings must be regenerated. This is of the first importance. By "gaps" is intended not necessarily the immediate neighbourhood of the felled stumps, but the often larger clearances made by the fallen crowns of trees (vide paragraph 404).

(5) The establishment of natural regeneration should be sought wherever possible. Groups of spontaneous regeneration and advance-growth should be freed and assisted ; scattered regeneration should be tended.

(6) Where natural regeneration is absent, measures shall be taken to induce its appearance where required, or alternatively, such localities should be artificially regenerated. Artificial measures may also be resorted to in certain instances in order to supersede existing natural regeneration or to form a mixture with species particularly desired if conditions are thought favourable. This is left to the discretion of the District Forest Officer.

(7) Artificial regeneration shall be limited in extent during the year of formation to no more than one-quarter of the total area of the coupe.

(8) Any portion of the coupe which is preponderatingly immature may at discretion be left for regeneration as well as exploitation to a later felling-cycle, but as far as possible portions thus neglected should possess adequate cover over the ground.

(9) All areas under regeneration must be fire-protected.

(10) All areas under regeneration will be excluded from grazing for seven years after felling.

347. *Suitability maps.*—After survey and demarcation of the coupe, a "suitability" map to the scale of 16 inches to 1 mile shall be prepared by the Range Officer and submitted to the District Forest Officer. A copy will be retained by the Range Officer. In the year prior to felling, all important topographical features will be entered together with other important details, viz., groups of advance-growth of timber species, the various principal types of undergrowth and such other information as will pertain to the future regeneration of the coupe. The presence of *Strobilanthes*, evergreen species, thorny climbers and young bamboo should be particularly noted. It is important that the District Forest Officer should come to a clear notion well in advance of felling as to the manner in which he proposes to regenerate the coupe and the several methods required. The "suitability map" should be with him at the time when he makes the sylvicultural marking. He should mark on the map those areas wherein he proposes to tend natural regeneration, those which he proposes to regenerate artificially, and those which he may decide to leave alone for the time being. After felling, the locations and numbers of the gaps made by the fellings will also be entered on this map (vide paragraph 394). The larger scale maps prepared by the Working Plans staff for certain localities in the regeneration area may be used as a guide for felling and regeneration. Conditions are susceptible to change, however, within a very few years.

B. Rules for the regeneration of deciduous forests.

348. Tracts occupied by deciduous forest may be roughly subdivided into four principal classes for the purposes of regeneration, these being described as follows :—

(*a*) Forests wherein advance-growth of *Xylia xylocarpa*, *Dalbergia latifolia*, *Pterocarpus Marsupium* and other deciduous species are present under partial shade of the overwood ;

(*b*) Semi-open localities containing advance regeneration of teak, *Terminalia paniculata*, *Terminalia tomentosa*, *Xylia*, etc., these having generally been burnt over in the past ;

(c) Moist tracts wherein natural regeneration of *Hopea parviflora* and *Artocarpus hirsuta* has become established;

(d) Localities where practically no advance regeneration is present. This class of area has resulted from various different circumstances, of which the chief are:—

(i) repeated fires, having destroyed the fertility or germinative capacity of the soil;

(ii) thick undergrowth and heavy shade resulting from protection;

(iii) the presence of pernicious types of ground-flora, such as *Strobilanthes*, Lantana, *Ochlandra* reed, *Oxytenathera*, or heavy climbers ("kochi" scrub).

349. The above various classes require separate methods of treatment. One or more of these conditions will be met with in each annual coupe, but rarely all, and the District Forest Officer should select for regeneration those types which he thinks he can deal with most easily and effectively.

350. (a) *Where advance regeneration of Xylia xylocarpa and other partial shade-bearing species is present.*—If *Xylia* is healthy and abundant it should be adopted as the major species in the young crop. *Dalbergia latifolia, Pterocarpus Marsupium, Artocarpus hirsuta, Albizzia Lebbek,* and all other desirable species should wherever present, be encouraged to form a mixture. If the young crop is plentiful, the attention necessary will rarely exceed the admission of light and freeing the heads of seedlings and root-suckers from encompassing weed-growth. Where regeneration is sparse, it should be stimulated by root-wounding, soil-working of hard laterite or heavy clay top surface around shade bearers, and by a light burn of the undergrowth, as early as possible after felling is completed, utilising dead branchwood and felling debris to assist the burn in the gaps. *Xylia* regeneration is invariably much stimulated by the admission of light; but the degree of opening in the top canopy must be chiefly determined by the accompanying type of undergrowth. Instructions on this matter are given in the paragraph dealing with silvicultural markings, and although in this type of forest it is expected that a more liberal breaking of canopy is possible, it is preferable to proceed with caution (as in the fellings in Porkala and Padnur reserves) until experience has shown exactly what procedure gives the most rapid and cheapest results.

351. (b) *Semi-open localities containing advance regeneration of Terminalias, teak, Xylia, and other species.*—Protection from fires and cattle, combined with a freeing from grass, weeds and climbers is necessary. If the area is exceptionally encumbered by herbaceous weed-growth a burn should be given in the month of February or March following the felling. All burnt and damaged shoots should be cut back to ground level. Coppice regeneration should be encouraged from suitable stumps which shall be dressed after felling. Stems of noxious species should be hacked. Retention of helpful cover (e.g., of *Phyllanthus emblica, Careya arborea, Strychnos Nux-vomica,* etc.,) may be advisable to keep down tall grass and weeds. Seed-bearers will be left on the area to assist natural restocking where regeneration is still inadequate, but as a rule all merchantable stems may be removed, since regeneration is assisted by direct light.

352. (c) *Moist localities where Hopea parviflora, Artocarpus hirsuta and other desirable evergreen species have become self-established.*—These species will generally exist as irregularly-spaced groups or as individuals among evergreen groundflora. *Xylia xylocarpa* is often present in admixture. The evergreen species should be given preference over deciduous species. Cultural operations shall consist in the liberation of seedlings and saplings from surrounding weeds to a radius of 3 feet around each, and the admittance of requisite light. The subsidiary rules for the removal of canopy over Hopea given in paragraphs 417 to 423 shall be followed. If the incidence of evergreen species is not uniformly distributed to desirable extent, artificial regeneration of intervening suitable areas shall be undertaken, up to one-quarter of the total area of the coupe. "Doubtful areas" should not be sown up with Hopea at regular espacement; groups in selected localities, sown broadcast or distributed in the manner described in paragaph 412 should give better and cheaper results. One-sixth of the area artificially regenerated shall contain *Artocarpus hirsuta.* This species should in the first instance be sown at stake in localities perhaps a trifle too open for Hopea, and in gaps occasioned by fellings. Casualties of both Hopea and *Artocarpus* shall be filled up for two seasons following the fellings, by one-year and two-year old nursery plants or two-year and three-year old stumps. Seed-bearers of Hopea and *Artocarpus* should be retained on the area for as long as necessary to enable the floor to become fully restocked with young plants. Where the undergrowth thins out or becomes deciduous in character, and the evergreen middle storey becomes sparse, *Xylia xylocarpa* is to be preferred as the principal crop, and evergreen species should not be installed.

353. (*d*) *Deciduous woods containing a negligible quantity of natural regeneration.*—These localities more than others will exercise the discretion of the management in deciding the cheapest means of securing regeneration. Prescriptions for this class of area are necessarily loose and entirely experimental in their scope. All that is definitely laid down is that primary attention shall be given to the successful regeneration of the gaps made by fellings. For the first few years until this problem is fully and successfully solved or an alternative reached, the management will not concern itself very greatly over regeneration of intervening spaces, except where they are manifestly suited to the easy introduction of *Hopea parviflora*. When gap regeneration is successfully achieved, attention may be given to the remaining portions of the coupe. The procedure for gap sowings and planting is given in paragraphs 396 to 401 and 409, 410. The following additional notes on the different types of forest under this head are made, suggesting the several modes of procedure to be adopted in each instance.

354. (i) Where soil covering is very sparse (due to repeated fires in the past) rigid protection from fires (vide paragraph 57) is essential until the soil has become rehabilitated. Moderately large gaps in the overwood are permissible, up to 15 yards square. These gaps will be artificially regenerated with deciduous species at prepared and staked patches, spaced 4½ feet apart. Teak stumps should be planted in the very centre of these gaps wherever the soil appears of sufficient depth. *Dalbergia latifolia* and *Pterocarpus marsupium* should occupy the outer two or three rows. Rootsuckers and seedlings of valuable species appearing spontaneously in the gaps should be encouraged as a supplementary crop. Coppice shoots of teak from trimmed stumps should be thinned during subsequent tending operations.

355. (ii) Where moist protected conditions have induced a heavy undergrowth and a well-advanced middle storey, the size of the gaps should be minimised to avoid subsequent weed-growth, and should generally be not larger than 12 yards diameter. The management must decide as a matter of policy and convenience whether to impart predominantly evergreen or deciduous character to the crop of the future. Again the guiding principle should be to *follow the undergrowth.* Where the undergrowth is pronouncedly evergreen, containing *Webera, Psychotria, Cinnamomum, Ixora Limonia, Actinodaphne,* etc., species accompanied by a middle storey of *Aporosa,* conditions may be assumed suitable for *Hopea parviflora* and *Artocarpus hirsuta* introduction, and the raising of evergreen crops is usually indicated. *Strobilanthes,* provided well admixed with other competing species, is not greatly detrimental to the health of Hopea. *Artocarpus hirsuta* will be introduced chiefly in the gaps created by fellings, provided there remains adequate cover to provide side shade. This species will be introduced both by seed and by nursery transplants. Experiments will also be made with stump transplants. Three-year old stumps of this species have been found, by the Provincial Sylviculturist to be in certain cases the most successful both from the point of view of percentage of survivals and of rate of growth. *Hopea parviflora* will be sown at stake around the edges of the gaps to a depth of 18 feet into the uncut forest. Where conditions suitable for Hopea exist over a portion of the coupe, as along sheltered valleys, the remainder being of a different type the District Forest Officer may decide to undertake regular plantations of Hopea in such small localities. Detailed instructions in the sowing of Hopea, and for later tending of this species are given in paragraphs 364 to 376. It is inadvisable to make extensive plantations under an overwood consisting mainly of young pole crops which will not come to maturity until the next felling-cycle. It should also be remembered that regular plantations will probably require intermediate fellings in the overwood, which may upset the yield.

356. (iii) Where the undergrowth is of a transitional character, containing *Leea, Glycosmis pentaphylla, Strobilanthes, Clerodendron infortunatum, Tabernae-montana Heyneana, Aporosa Lindleyana,* etc., accompanied by a not well-advanced middle storey, regeneration by modified light-demanders, preferably fast-growing species, is thought to be advisable. Often this type is accompanied by a considerable proportion of *Xylia xylocarpa* in the upper canopy, regeneration being suppressed by the lower vegetation. If so, regeneration of this species should be stimulated by the cutting and removal of undergrowth and trenching around trees marked for felling early in March of the year prior to felling. If this is inadequate, the gaps will have to be regenerated artificially. *Strobilanthes* where present in the gaps should be dealt with as described in paragraph 357. The following species will be introduced in the gaps in the order of preference named:—*Artocarpus hirsuta, Dalbergia latifolia, Acrocarpus fraxinifolius, Artocarpus integrifolia, Pterocarpus Marsupium, Swietenia macrophylla.* Should however, one or other of the less preferred species prove markedly more successful and get away faster than the others mentioned, it should be generally adopted in admixture with the more valuable species in order to act as a nurse in drawing up the latter, and in keeping down weeds. An experiment is prescribed (vide paragraph 415) for the controlled burning of undergrowth in localities where regeneration is sparse.

357. (e) *Regeneration of areas containing growth-types inimical to regeneration of tree species.*

(i) *Strobilanthes.*—There are several species of *Strobilanthes,* some more inimical than others, but all are liable to take possession of the ground if too rapidly uncovered to direct light. *Strobilanthes* may be kept in check and finally reduced by rentention of cover (especially of an evergreen middle-storey), or by cutting it right down to ground level beneath the collum or by repeatedly burning it off. A single burn appears rarely to destroy the species. The method of cutting all stems right down to ground-level (that is to say, across the ærial portions of the root-systems below the point where they join the stem at the collum) should be tried first in all gaps, and for a further space of 10 yards around the gaps, where this species is in abundance.

(ii) *Ochlandra reed—Hopea parviflora* can be regenerated under *Ochlandra* reed (" Watte ") by cutting lines 12 feet wide through the reed, and by sowing seeds in prepared patches 9 feet apart in the normal fashion. If this is unsuccessful, one-year old transplants should be tried. No attempt shall be made to regenerate areas containing heavy growth of the large *Ochlandra* reed (" Ame Watte ") ; experiments on a small scale may be made if the management thinks fit.

(iii) *Heavy climbers.*—These may form a complete impenetrable thicket in exposed places. No experience has yet been obtained in the best methods of dealing with such areas. If extensive, with little accompanying tree-growth, such areas should be left. If in small groups only, it is suggested that the areas be burnt as thoroughly as possible in March, after fire-tracing around the perimeter in order to prevent escapes. The areas should then be close-sown with fast-growing adaptible species preferably throwing heavy shade, such as *Vateria indica, Mangifera indica, Gmelina arborea, Artocarpus integrifolia, Swietenia macrophylla.*

(iv) *Lantana.*—Areas where lantana is thick should be left alone, and the canopy in adjoining forest disturbed to the minimum extent, so as not to endanger further spread of this species.

C. Regeneration of Hopea parviflora and evergreen species.

(i) General note on the conditions requisite for the raising of *Hopea parviflora.*

358. The difficulty of laying down prescriptive rules for rigid application to the raising of *Hopea parviflora* under all conditions necessitates rather that the present plan should enunciate general principles to be followed by the management. In order that the reasons for each modification of treatment to individual circumstances should be understood, the following note is given for general guidance, and is to be applied until experience provides more adequate knowledge. After allowances are made for individual characteristics of other evergreen or semi-evergreen species besides Hopea, the general principles will still take effect.

359. (a) *Limiting factors.*—The rate of growth during the precarious early life of Hopea, i.e., up to about the tenth year, is rather slow, and constant care and tending is necessary. The rapidity of growth—and therefore the cost of establishing the crop in inverse ratio—is *definitely regulated by the measure of its least favourable factor of environment in each individual instance.* These factors are not quantitatively established, but the principal ones to be borne in mind are stated below :—

(i) In the shade of natural evergreen forest the limiting factor for germination and healthy metabolism of the young plant is inadequate light during the growing-season, which is that period of greatest precipitation between the middle of May and the end of November. Growth is probably prolonged beyond this period in moist localities, but during cloudy weather the shade cast by the several layers of canopy is far too intense to stimulate perceptible growth. Observation appears to show that in perennially moist situations Hopea is capable of healthy growth even when directly exposed to overhead light throughout the year.

(ii) In drier deciduous localities the limiting factor is a deficiency in soil and atmospheric humidity during the dry-weather months, resulting in desiccation of the young tissues, a bushy stunted habit, or not infrequently death. In localities apt to suffer from drought it is essential to retain overhead as well as side shade for young plants until they have established root-systems and woody stems adequate to carry them through the driest months of the year.

(iii) In many deciduous localities, where Hopea is being established for the first time, growth appears frequently to be delayed for several years owing to the difficulty experienced by the young root-system in penetrating the hard resistant surface soil layers, especially if these be of a lateritic nature. The necessity for breaking up the soil to permit easy and rapid development of the roots in such places is of primary importance to success.

(iv) In heavy clayey loams and badly drained situations, young Hopea plants are adversely affected by lack of æration and from "drip" from low shade. Periodical soil working around the roots during the course of tending operations, and the withdrawal at an early date of overhanging low shade is necessary.

360. (*b*) *Indications of suitability of the locality.*—Circumstances favourable to the germination and growth of Hopea are generally occasioned by (i) a fairly high level of the underlying water-table; (ii) a good depth of decomposed humus and organic matter which provides that adequate hygroscopic moisture in the soil interstices is retained during the driest months. Sufficient indication of such favourable circumstances is generally provided by the quality of the undergrowth. The type of vegetation in the top canopy is of relatively little importance and so far as suitability to Hopea itself is concerned, may be virtually ignored. The thriftiest specimens of Hopea saplings are found when in the neighbourhood of small trees or bushes in semi-open maidans after the manner in which Sandal is raised. Amid ideal conditions of ground-flora, Hopea will continue on the other hand to exist indefinitely under heavy shade although making small progress. The most suitable associates among the ground-flora for the introduction of Hopea are *Webera canarica, Webera corymbosa, Psychotria truncata* and species of *Ixora.* Others generally present are: *Cinnamomum Zeylanicum, Limonia acidissima, Aporosa Lindleyana, Toddalia bilocularis, Actinodaphne Hookeri, Mallotus phillipinensis, Memecylon malabaricum, Leea sambucina,* etc. Other species characteristic of the moist deciduous and sub-evergreen types; e.g., *Curcuma,* filicales, are minor indicators of suitability (as also is the presence of leeches), but reliance should not be placed on these alone.

361. (*c*) *Choice of locality for artificial introduction.*—Almost all evergreen, sub-evergreen, riverain and moist sheltered conditions are suitable for Hopea in greater or less degree. For artificial introduction of this species however, the moist deciduous type of forest has definite advantages, the principal of which is cheapness. The majority of the overwood which will need to come out in the course of regular and subsidiary fellings is of saleable species, this being rarely so in evergreen and sub-evergreen types. The fellings can be better regulated and do generally less damage to the rest of the forest and to the young crop. There should preferably be an under-storey of smaller evergreen trees which will allow scope to some nicety in the adjustment of light incidence to the young crop. A preponderance of thick-leaved, stocky, evergreen species of the *Webera-Psychotria* type should be looked for. These grow to no great height, and are instrumental in keeping down climbers and other faster-growing species, as well as being protective to the soil when the canopy is opened. Localities containing bamboo regeneration, *Strobilanthes, Helicteres Isora, Zyziphus œnoplia, Hybiscus furcatus, Randia* spp., and herbaceous climbers should not be chosen except when these species are in very modest minority. Evergreen and sub-evergreen localities will probably require to be regenerated with evergreen species as well as [illegible], the successful raising of an artificially introduced crop of the latter at regular espacement is liable to be more difficult in the long run and will require greater skill here than in moist deciduous forest. The principal reasons for this are that openings in the top canopy during fellings are necessarily larger, they need to be supplemented by girdling of valueless trees, and a varied ground-flora containing a multitude of tall-growing herbaceous weeds and fast-growing evergreen tree specie[illegible]e apt to take possession of the gaps and oust the Hopea. Such localities would th[illegible] require considerable care during fellings and annual attention may be necessary to the young crop until it has well overtopped competing weeds, which may take any period up to 15 years.

362. (*d*) *Progressive stages of development and general sequence of operations.*—The management should aim throughout at securing those ideal conditions of shade from the overwood which while stimulating height-growth will yet keep unwanted weeds and adventitious species in check. The methods required to secure these conditions will vary according to the nature of the locality right from the very start. *The limiting factors described in paragraph* 359 *should invariably be borne in mind, for until these are overcome all work which aims at improving other subsidiary factors will be entirely in vain.* Hopea seedlings require a certain amount of overhead shade during early youth, i.e., up to about the fifth year. Thereafter gradual and progressive removal of shade, according to the state of advancement and general requirements of the crop, should be made at intervals. There are two periods during which shade is necessary:—(i) while the young plant is establishing itself in its environment, the period being longer in deciduous localities than in true rainforest; (ii) subsequently, to that degree necessary to prevent other growth gaining the upper hand and getting beyond control of the staff. These two conditions being satisfied, the more rapid the shade removal, the better. "Little and often" is the best procedure. Young plants are sometimes observed to grow rapidly for some years and then appear to falter in development directly they become encompassed by vigorous herbaceous species having an extensive root-system at the same level, such as *Leea* and *Strobilanthes.* This

condition requires careful watching, and where it occurs, a thorough and heavy weeding is necessary. Similarly, natural thickets of Hopea, which have advanced in an almost pure formation up to the stage when complete removal of shade is permissible have sometimes been observed to lose vigour and the new flush of young shoots to die back annually. This is believed to be due rather to excessive root competition for soil moisture than to direct exposure, '*per se*' since individual stems in identical circumstances show no such retardation in growth.

Properly conducted cleanings should avoid this but should it be seen to occur, the crop should be thinned out without delay. More detailed instructions with respect to the various tending operations and subsidiary fellings are given in paragraphs 373—376 and 417—420. In natural Hopea regions, resort to artificial regeneration should be minimized ; emphasis is placed upon the desirability of obtaining advance reproduction of seedlings on the ground *before* principal fellings are undertaken. This is particularly desirable in ghat evergreen jungles containing a large variety of non-utilizable species among which Hopea is comparatively scarce and starts life often at considerable disadvantage.

363. (*e*) *Protection against disease.*—Hopea is open to attacks during youth from insect pests which rob it of fully 50 per cent of its normal height increment, and account for many deaths. During later years it is very liable to attack from fungus and from wood-borers. No measuers of control have yet been devised, and the life-histories of insect enemies have not been worked out. Casualties should be minimized by the immediate removal as soon as observed of all diseased specimens and decaying stems. Suppressed individuals in the early stages are particularly susceptible to insect borers, which may spread to healthy stems in the neighbourhood. Similarly, trees in all ages found in the immediate neighbourhood of decaying stumps, and dead, broken, or diseased stems, have been very frequently observed to be also attacked both by borers and fungi, and it may be taken as almost certain that such stems will in time succumb. Since in future crops the proportion of Hopea should be much higher than it is at present, it is highly important that the subject be further investigated, the life-histories of insect enemies worked out, and every endeavour made in the meantime to reduce circumstances favourable to attacks.

(ii) Artificial Reproduction of *Hopea parviflora*.

364. *Selection of site.*—Hopea is to be artificially introduced in the coupe of the year only in localities which promise a high percentage of success and where excessive annual expenses in the subsequent tending of the young crops is not anticipated. If such do not occur Hopea will not be introduced.

Careful selection of localities within the coupe to be regenerated shall be made by the District Forest Officer in person on the ground prior to the sylvicultural marking. These localities will be roughly surveyed and marked on the "suitability map" (paragraph 347).

Uniform plantations over whole compartments or coupes shall not be undertaken without special sanction being obtained from the Conservator.

365. *Year of sowing.*—Provided that a middle storey of evergreen trees is well represented and the undergrowth gives adequate protection against evaporation in the hot weather, sowing can normally be done in the year subsequent to felling. In years of prolific seed-fall and if funds are available, the operation may be more cheaply and safely undertaken prior to the felling, but some damage during extraction to the young crop is to be expected in this case and must be subsequently made good.

366. *Collection of seed.*—Seeds of *Hopea parviflora* ripen in May and June. They quickly lose germinative power. Fresh ripe seeds must therefore be collected immediately before they are required for sowing. Good vigorous trees with healthy crowns should be selected while in flower, and watched, when seed-fall begins to take place in quantity, just before the break of the monsoon. Newly-fallen seed will be collected from the ground. Full seed-years occur only once in 4 or 5 years, but partial seed-production is usual for one or two years intermediately ; if failure is anticipated in one locality, arrangements must be made well in advance for the collection of seed from other localities in the district. If failure is general in South Mangalore Division recourse can generally be had to reserves and private "hadis" in North Mangalore Division. One bag holding 2 muras (1 'mura' = 42 seers) will contain about 22,000—23,000 seeds ; 38 measured seers should contain a sufficient number of seeds for 1 acre sown at 9′ × 9′ espacement. The weight of winged seed is about 70 to the ounce. Collection costs from about 12 annas to 1 rupee per bag, including cost of bags.

367. *Nursery.*—A nursery should be formed for the replacement of casualties to the extent of about 15 per cent in the sown area of the same year, plus about 25 per cent in the area sown during the previous year. The nursery should be prepared in good moist humus

soil on almost level ground having a gentle drain-off, preferably near the bank of a stream. It should possess good overhead shade. The site should be cleared of undergrowth and low shade. A convenient size for the beds is 24—30 feet long and 4 feet wide. There should be a space of 2′ 6″ between the beds. The bed will be dug and thoroughly hoed to a depth of 1 foot. All stumps, roots and large stones should be removed, and the surface neatly levelled at about 3—4 inches above the surrounding earth level. Small drains should be constructed along either side of the beds to carry off surplus water during heavy rains. Seed should be sown broadcast, but not too thickly, between the beginning and the middle of May. If the sowing is not made too thickly in the first place pricking out is unnecesary, but overcrowding should be avoided. There can be between 2,500 and 3,000 seedlings in a bed. If there is heavy drip on to the beds during the rains a sloping pandal open to the side giving greatest light should be erected over the beds. In the hot weather months, seedlings will be watered daily in the mornings. A watering-can with a rose attachment should be used. The beds must be maintained moist but not water-logged, and the surface should be kept broken and free from weeds. If seedlings show signs of withering pandals will be erected to give extra shade.

About 3 to 4 beds may be required annually, and the cost will be about Rs. 25 to 30.

Artocarpus hirsuta seedlings may conveniently be raised in the same nursery. Seedlings up to three years old will be required for stumping. These will be put in separate beds. General conditions will be similar to those required for Hopea, but seedlings will require thinning out in the second year to an espacement of about 4 inches. The nursery should be well-fenced if *Artocarpus* is raised therein. The Provincial Sylviculturist should be consulted in regard to the best method of regenerating this species.

Formation—Sowing and Planting.

368. *General.*—The normal practice in the division for the past several years is here prescribed. Except for certain experiments which are to be carried out in suitable localities, and which are described in paragraphs 412 to 414, the normal procedure shall be adopted until the practicability of alternative methods is fully assured. The crop should be established during the early part of the monsoon.

369. *Aligning and staking.*—This should be begun in February or March. Exact accuracy in alignment and espacement is unessential and should be subordinated to cheapness. The normal spacing of stakes shall be 9 feet apart in both directions. Planting lines can be offset from two base lines cut across the area at right angles. Stakes will be cut from durable species 3 feet long and about 1½ inches diameter, roughly pointed at one end. They should be cut beforehand and made up into bundles of 50 or 100. Distances will be paced out along planting lines and the stakes inserted firmly every 9 feet. The number of the stakes used will be checked at the end of the operation. If the experiment described in paragraph 412 is successful and less costly than ordinary methods of aligning and staking, modifications in practice may be adopted in all compartments.

Where damage from grazing by wild animals is anticipated, the sown patches will be placed 2 feet away.

370. *Soil working.*—Around each stake the undergrowth will be cleared to a radius of 1′ 6″. A hole one foot square and 10 inches deep will be dug with a pick-axe. If the soil is hard gravelly laterite, the depth of the pit should be increased to 12 inches. The soil excavated should be well broken up and replaced. The sides of the pits should not be exposed for long, and a mulching of leaves over the patches is considered advisable during the dry weather. Soil-working should be completed by the 15th May. In soft, deep soil supporting a tall heavy crop, as in first-class moist deciduous or semi-evergreen localities, pitting as described above need not be done ; instead top layers of soil only will be raked over.

371. *Sowing.*—Collection of seeds should be commenced about the 1st June, or just before this if the monsoon promises an early approach. Seed must be sown within two days after collection. It must be transported to the sowing locality on the same evening as collected ; if it comes from some distance the utmost despatch must be exercised during transport, and the bags should not be exposed to the rays of the sun. All sowing ought to be completed by about the 7th June. In each staked and prepared patch, 10 or 12 seeds will be lightly dibbled ; that is to say, they should have a light sprinkling of earth over them in order to retain them in position, but not more than ¼ inch in depth.

372. *Replacement of casualties.*—During the year of formation, casualties should be replaced as they occur. The first replacement will be in July. Three seedlings should be placed in each blank patch, in the form of a triangle. They may be taken from the nursery, or from patches containing a superfluous number of seedlings. The plants must be carefully

handled so as not to damage the delicate root systems. In planting, a hole is first made with a strong pointed wooden stake about ¾ inch to 1 inch in diameter to the exact depth to which the root will go in the soil; the plant is then held in position while earth is packed around it and the stake should be used to close the hole. It is important that roots be not bent over on themselves, and careful supervision during this operation is highly essential. Casualities will be replaced during the second year by one-year old seedlings from the nursery, and not subsequently.

373. *Weeding and climber-cutting.*—No weeding shall be done in the year of formation, and in the following year only in cases where the weeds threaten to cover the patches. If there is danger from excessive drought or transpiration during the dry weather, a mulching should be given during the first two years, but this should not normally be necessary. In the third year of formation the weeds should be thoroughly cleared for a distance of 3 feet around each patch, to remove root competition. In successive years, weeds should be cut down below the level of the heads of Hopea, where there is danger of active interference, and the clear space of 3 feet around the patches maintained as well as possible. All climbers shall be cut at the same time as the weeding. This operation should normally be done in August or September the former month being preferable if weed growth is prolific. It is anticipated that some tending combined with climber-cutting will be normally required up to the tenth year, this being largely the duty of the beat guard, except when special provision is made in the budget for more intensive undertakings. No definite prescriptions for a tending programme can however be laid down. It will be restricted in practice by limitations of staff, but following the years of subsidiary removals of canopy, a tending and climber cutting should be given. If weed growth threatens to become tall after the fifth year, a clear space of 5—6 feet around the Hopea plants is advisable, in order to permit free root development.

374. *Pruning.*—The stems of Hopea grown under shade are usually frail and easily damaged during early years. No pruning of the stems need be done until woody growth is well developed around the lower portion of the stem, and the plant established sufficiently to be free from all ordinary dangers. Double leaders can be pruned after the plant is about 6 feet high but this is left to the discretion of the management. Damaged stems should be cut back with a clean cut to about three inches above ground level, at any time they are observed.

375. *Removal of diseased plants.*—The survival plants at a single patch is usual. One or two will usually get ahead of the remainder. Provided the smaller individuals are healthy, they should be allowed to remain for protection to the more advanced stem and to encourage in it a clean straight habit. Suppressed individuals are however apt to become attacked by insect borers and other parasites, which may subsequently attack healthy specimens. Ill-favoured and obviously unhealthy plants should therefore be removed (if possible by uprootal) during tending operations.

376. *Removal of shade.*—All very low overhanging shade likely to cause ' drip ' should be removed in the first year of formation. In Hopea plantations of the past, the evergreen underwood up to 25 or 30 feet high has been removed usually (but not always) in about the third year of formation. This may have been a trifle premature in some instances, but if the operation is postponed until the sixth year or subsequently, the growth of seedlings has been decidedly impeded. In this working circle, the programme of operations as shown in the tabular statement (vide paragraphs 429 and 430) does not provide for intensive operations to a coupe after the third year until the District Forest Officer himself prescribes during his inspection in the fifth year after felling. Thus, while no definite prescription regarding the actual year of shade removal is laid down, it should be borne in mind that if low shade is not removed during the first three years, it will necessarily remain until the sixth year or even later, which may be detrimental to the crop if shade is heavy. It is accordingly *suggested* that some low shade be removed during the course of the first three years, but that this be done with caution, lest weeds gain the upper hand thereafter. If the locality has been well chosen, no detriment to the crop is likely to result from a moderate exposure of the ground to light, provided there is still an upper leaf canopy to give broken shade, but there *may* be danger from weed-growth unless the operation be done with care. The District Forest Officer should give very precise instructions for further shade removal after his quinquennial inspection of the coupe. He will enter these in the Control Journal.

(iii). Natural Regeneration of *Hopea parviflora* and other evergreen species in evergreen and sub-evergreen localities.

377. *Preliminary.*—For an understanding of past experience gained in the raising of natural crops of *Hopea parviflora* and associated species, the reader is referred to paragraphs 215—219 and 227—233 of Part I which give a brief summary of the results obtained in Jalsur

East, Nalkur and Aletti West reserves. Future operations will approach most nearly those methods adopted in Nalkur reserve. The operations oultined for the future consist of (*a*) preliminary work to stimulate advance growth of useful species, (*b*) removal of exploitable crop, (*c*) subsidiary operations subsequent to removal of the mature crop. These operations will be undertaken in Puttur Felling Series 'A' and 'B.'

(*a*) *Operations to precede fellings in the mature crop.*

378. *General purpose.*—In sub-evergreen and evergreen forests young *Hopea parviflora* is at once one of the slowest growing and one of the strongest light-demanding species among the ground-flora. In mature evergreen forests, regeneration of Hopea is notably suppressed and often virtually absent under the dense shade of parent trees. In transitional or sub-evergreen types, regeneration may be thickly established in favourable localities while sparse in others, but in most cases subsisting under heavy competition from other species. Unassisted, *Hopea parviflora* stands small chance of success in the final crop unless it is in thicket formation from the start. In order that artificial regeneration of evergreen forests shall be avoided and so that expensive weeding and tending operations after removing the principal seed bearers shall be minimized, the importance is emphasized of securing a great number of seedlings on the ground and of giving them the utmost possible start over their faster-growing neighbours before the major felling is begun. In the evergreen *Dipterocarpus* forests of Malaya this principle is recognized by the application of "Regeneration Improvement Fellings" for at least five years in advance of actual removal of the exploitable crop. This final removal is liable to postponement until survey and countings show that regeneration is entirely satisfactory. Preparatory operations of this nature although imposing additional duties on the divisional staff in the earlier stages should materially shorten the labour and attention necessary at later stages. The intention of the preparatory operations hereunder prescribed is (i) to provide increased light at soil level adequate to assist germination of seed when it arrives, (ii) to take advantage of at least one good seed year before felling the seed bearers, (iii) to encourage advance growth of all desirable species, so that they might get a start over their more undesirbale neighbours while the undergrowth is still well under control.

379. *Classification of areas.*—Each coupe shall be examined and classified by the Range Officer in January or February of the year in which it is first to receive attention. The area should be divided into categories, according to the state of regeneration of desirable species already on the ground, and marked on the suitability map for the coupe. The following classifications will be adopted :—

Class I areas—containing advance growth and seedlings in considerable density practically occupying the ground. Such areas are generally limited, but may contain up to 80,000 or 90,000 seedlings and saplings per acre.

Class II areas—containing a useful but more scattered growth of seedlings and saplings not in dense thicket formation, but averaging at least 500 per acre.

Class III areas—containing at least 200 seedlings and saplings per acre of useful species.

Class IV areas—containing a negligible number of seedlings found only at wide intervals apart.

Preparatory Operations—Prescriptions.

380. *First year.*—(i) Girdling is prescribed of trees of non-utilizable species up to 35 feet height for a radius of 15 yards around seed bearers. On slopes having a northerly or north-easterly aspect and on those with exceptionally dense shade, a *light* opening of the upper canopy by girdling of unmarketable trees may be made in addition. Small trees of the middle storey may be felled if this is cheaper than girdling. This operation should be carried out in all classes of area enumerated above.

(ii) A clearance of weeds and climbers so as to free all seedlings shall be done as follows :—

Class I areas.—Throughout ;

Class II areas.—Lines will be cut through the undergrowth eight feet wide and distant 20 feet centre to centre.

In the clearance of lines through class II areas, difficulty is anticipated in being able to judge in advance how seedlings are disposed in the dense undergrowth. By accident of location it might happen that only a few seedlings are disclosed in the actual lines whereas promising seedlings or saplings only a foot or two off the line are left untended. Lines are only of value when seedlings are fairly evenly distributed. Lines will therefore be cut only 2 feet wide in the first instance. The Range Officer will then personally inspect the lines and direct the forester in charge where they are to be widened to 8 feet. Blanks in the natural stocking are thereafter apparent. The position of cut lines shall be

semi-permanently indicated by small stone cairns where they cross coupe boundaries and inspection paths. This is necessary in order that their location be not subsequently lost sight of in the undergrowth.

381. *Third year.*—No further opening will be made in the canopy. A further freeing of seedlings by reduction of undergrowth and low shade in classes I to III shall be made if necessary. In class II areas, care should be taken to reopen the original lines, not fresh ones.

The operations here prescribed for the third year will be left to the discretion of the management, whether they be fulfilled during the second, third, or fourth year, the actual time being determined by the requirements of the crop, the occurrence of a good seed-year, and administrative convenience.

(b) Exploitation of the mature crop.

382. *Fourth year.*—In this year marking for felling is made (vide paragraph 336). The exploitable limits for evergreen species is 6 feet at breast-height or above buttresses. Diseased Hopea stems of below this limit should however be marked. All trees of sleeper species and others saleable in the log should be marked for removal, provided that an even distribution of residual top canopy remains for protection of the young crop. Very large gaps in the canopy are to be avoided, but no minimum spacing of gaps is prescribed in the case of Hopea. Up to a maximum of 40 per cent of shade removal would be admissible if advance growth is already present in considerable abundance. The degree of felling should rarely exceed however, four trees per acre. Giving an opportunity for rank weed growth to obtain a hold on the area must be very rigoroulsy avoided. Upon the skill of the marking officer at the time of the sylvicultural remarking (vide paragraph 337), much depends. Successful preparatory operations, combined with judgment in the removal of the upper canopy are the only possible ways of keeping down subsequent expenditure and of minimizing the mortality among the young seedlings. The removal of all seed bearers from a locality is equivalent to " burning one's boats " and should be avoided if possible by the retention of one or two trees, even though they be of exploitable size, unless the floor is already quite adequately stocked.

383. *Fifth year.*—The felling of the mature crop (vide paragraph 378) is conducted in this year as early as possible after the seed has fallen. The ordinary prescriptions are to be followed.

384. *Sixth year.*—(i) *Inspection paths*—These should be cut according to the general rules given in paragraph 619, but if Hopea is chiefly located in certain portions of the coupe while absent in others, principal regeneration centres for the time being should naturally be made the more accessible while in the case of regeneration being concentrated in dispersed gaps, the inspection paths should be constructed to link up the gaps in the best manner possible.

385. (ii) *Tending of natural regeneration.*—Seedlings bent or broken by the felling operations should be cut back, and all felling debris removed from around regeneration. A fresh survey of the coupe should be made and areas reallotted to the different categories according as they have benefitted from the previous operations. Weeding shall be conducted intensively in classes I to III. The importance of keeping weedgrowth severely in check during the first three years after removal of canopy in these localities is strongly emphasized. In the first two years at least two weedings, the first in July and the second in September shall be conducted each year, and, if these are insufficient to prevent the weeds overtopping and tending to obscure the young crop, a third weeding shall be given in December. If the first two weedings are performed thoroughly and effectively, by cutting the stems of weeds not far above ground-level, the third weeding can probably be dispensed with. In class I areas, every effort shall be made to obtain a close and almost pure thicket of *Hopea parviflora* until the crop is out of danger from competing growth. In class II areas, old lines should be recleared to the full width of eight feet. In class III areas, staked plants shall be weeded and climbers cut for a radius of three feet.

386. (iii) *Artificial sowing and planting.*—Blanks occurring in class II areas should be filled up artificially by one-year old transplants from the nursery or the natural forest at an espacement of about 9 feet along the cut lines. The lines in such blank localities will have been but barely maintained and should now be widened to 4 feet. The planted seedlings should be staked. In class III areas, the total should be made up to about 500 seedlings per acre. If conditions are thoroughly suitable, this can be done by broadcast sowings in selected patches or strips, or again by the simpler method of spacing described in paragraph 412. In class IV areas, regeneration shall be confined entirely to the direct environment of the gaps created by the fellings. *Artocarpus hirsuta* seeds shall be sown

in the centre of these gaps and *Hopea parviflora*, if not already present in sufficient numbers, shall be sown round the edges and for a depth of about five yards into the uncut forest around the gaps. The principles described in paragraphs 403—410 should be followed, and the gaps numbered. The area artificially regenerated should not however, exceed one-third of the total extent of the coupe.

387. (iv) *Tending of species other than Hopea parviflora.*—The crop will inevitably contain a mixture of other species, of which the more important are to be encouraged. The order of precedence to be given to these species is *suggested* in the following sequence :—

(1) *Artocarpus hirsuta, Mesua ferrea, Cedrela toona ;*
(2) *Dipterocarpus indicus, Calophyllum tomentosum, Dichopsis elliptica ;*
(3) *Hardwickia pinnata, Eugenia Gardneri* ;
(4) *Vateria indica, Mangifera indica* ;
(5) *Diospyros sylvatica, Lophopetalum Wightianum, Hopea Wightiana, Alstonia scholaris*, etc.

For example, a *Dipterocarpus* or a *Dichopsis* seedling should be selected for preference over a neighbouring *Hardwickia* or *Eugenia* seedling. If choice becomes necessary between two seedlings of species listed under the same numeral, the better developed individual should be favoured. It is open to the personal discretion of the District Forest Officer, at any time to alter the above sequence, even to giving priority of any species over *Hopea parviflora.* A well grown *Artocarpus hirsuta* sapling should almost invariably have preference over a Hopea individual. Provided that not less than 500 seedlings, saplings or young poles up to three inches in diameter of accessory species listed in classes (1) to (3) inclusive are present per acre in a locality, artificial regeneration of Hopea should not be resorted to, and regeneration may be considered adequate.

388. *Seventh year—Replacement of casualties.*—Casualties in artificially sown areas shall be replaced by one-year old transplants picked out from the nursery or from the natural forest. They shall be placed at each blank patch in the form of a triangle six inches apart at the corners. All missing or fallen stakes shall be replaced. No replacement of casualties will be done after this year, but any other useful species will be encouraged instead.

389. *Weeding and climber cutting.*—This will be carried out if necessary. Importance is attached to the thorough removal of climbers from growing stems.

390. *Eighth, ninth and tenth years.*—Weeding, climber-cutting and general tending operations will be carried out to the extent necessary. This should be done by the beat guard. After the Hopea is well established, surrounding weeds and subsidiary growth should not be unduly restricted, as they assist in developing the necessary height-growth of young saplings. It is enough if the heads of saplings are kept free, but cutting back should be sufficiently drastic to prevent weeds from again closing over during the interval before the next tending operation, which at this stage can conveniently be after two or three years.

In the tenth year, i.e., when the young crop is five years or more old, the District Forest Officer shall inspect the coupe carefully and state in the Control Journal how far the operations have succeeded, and in what respects they have fallen short. He shall also record his opinion regarding the condition and vigour of the crop, which portions of the crops might be said to have regeneration established upon it, and what further work, if necessary, is to be done.

391. *Eleventh to fourteenth years.*—No definite procedure is laid down, and all operations will be at the discretion of the management. Some further removal of top canopy is anticipated, and reduction of shade shall be made in accordance with instructions contained in the subsidiary operations. A cleaning is anticipated also to be necessary in class I areas during this period.

D. Regeneration in gaps.

(i) General rules.

392. Artificial regeneration of gaps caused by the fellings is rigorously prescribed wherever there is inadequte natural regeneration or advance-growth of useful species already in occupation. It is difficult to define in words exactly what may be considered as " adequate " natural regeneration ; to large extent the District Forest Officer must himself decide. The management may have undertaken preparatory operations to induce natural regeneration by processes already prescribed, such as trenching (paragraph 356), or in accordance with the instructions in paragraphs 380 and 381. The adequacy of these operations will be seen in due course. In general, natural regeneration should be relied upon only when already present on the site in established groups which are unlikely to be suppressed by

subsequent weed growth. All that is definitely prescribed in this connection is that the replenishment of gaps shall not be left to the fortuitous unaided processes of nature. The procedure should be: "When in doubt, use artificial methods," which however may be supplemented by spontaneous natural regeneration. The method is admittedly one in which little experience has hitherto been gained, and not free from certain drawbacks, particularly in the matter of economy of supervision and labour. To this end, i.e., economy combined with efficiency, the efforts of the staff must be largely bent during the first period of this plan and modifications in the details of treatment will doubtless be suggested from time to time, which may be applied with the permission of the Conservator.

393. During the period of this plan, the principal object will be to obtain information on the following points :—

(*a*) The best methods to be employed, and the most suitable species to be introduced in the several types of forest commonly found ;

(*b*) the cost of application on a large scale, and the organization of labour to the best advantage ;

(*c*) the size of the gaps which appear to produce the best results ;

(*d*) how tending and supervision are to be minimised.

394. *Selection of gaps.*—As soon as possible after extraction is completed the District Forest Officer will select and mark with numbered pegs those gaps which will require artificial regeneration. These numbers will subsequently be transferred in tar to a conspicuous adjoining tree and the numbers kept freshly painted thereafter. The position of the gaps will be shown on the suitability map (16 inches to 1 mile scale).

395. *Choice of treatment.*—(*a*) When the forest is prevailingly deciduous in character, the gaps will be regenerated with deciduous species.

(*b*) When the undergrowth and surrounding vegetation is prevailingly evergreen, unaccompanied by natural regeneration of useful species, the gap is preferably regenerated with evergreen species.

(*c*) When the vegetation is of transitional type, the District Forest Officer must exercise discretion whether to cut and burn the undergrowth and regenerate with deciduous species, or to introduce modified light demanders which are benefited by the proximity of other growth.

(ii) Rules for the artificial regeneration of gaps with deciduous species.

396. *Size of the gaps.*—The minimum size of the gaps will be 8 yards square, and for the present should not exceed 12 yards square unless for special reasons which are inevitable. If the minimum dimensions of the gap are not at once secured by the fall of the tree the gap should be enlarged by cutting away useless surrounding growth, bamboos, etc.

397. *Clearing of the gaps.*—In November and December unsaleable crownwood will be cut into billets of suitable length and piled along with felling debris evenly over the ground in the gap. It should not be heaped in the centre as this causes too fierce a burn and will char the surface soil. It should be left to dry for a month or two.

398. *Burning.*—The piled debris should be burnt in March, or earlier if possible. The earlier the burn, the less danger there will be from escapes into the surrounding forest, which must be rigorously prevented. The burning will take place early in the day and there must be sufficient coolies available to prevent escapes beyond the gaps.

399. *Fire protection.*—The coupe will be fire-traced all round to a width of 12 feet before burning is commenced within the coupe.

400. *Soil working and staking.*—The gaps will be staked at approximately four and a half feet intervals. The soil at each stake will be worked to a depth of ten inches, the ash being well admixed with the lower soil.

401. *Species.*—In all apparently suitable localities, teak stumps will be planted in the centre space so that about one-half the area of the gap is thus planted. At the outer stakes *Dalbergia latifolia, Terminalia tomentosa* and *Pterocarpus Marsupium* seeds will be dibbled.

402. *Replacement of casualties, weeding and tending.*—See paragraphs 409 and 410.

(iii) Rules for the artificial regeneration of gaps with evergreen and modified light-demanding species.

403. Regeneration with evergreen species can be carried out in moist deciduous forest containing a heavy evergreen undergrowth. This does not however preclude the management from introducing deciduous species after clearing the undergrowth and burning it

in the gap in the manner just prescribed more particularly in order to ascertain and compare the cost of formation and tending by the two methods. Deciduous species are not however to be introduced in true evergreen or sub-evergreen localities, wherein the measures hereunder prescribed should be adopted in all circumstances where preparatory seeding operations have not been carried out in advance of extraction or have for any reason proved ineffective, and natural regeneration is sparse.

404. *Size of gaps.*—The gaps should be no larger than those caused by the actual felling. It should be remembered that when dealing with large evergreen trees the gaps caused by the fall of the tree is usually larger at the crown than around the stump. It may be necessary to deal with both gaps. All that is definitely prescribed is that the larger of the two gaps should be effectively regenerated.

405. *Clearing the gaps.*—The gaps will be cleared of branchwood and felling debris as soon as possible after logging and extraction are over. Pernicious climbers and weeds should be cut back, but otherwise the subsidiary growth need not be unduly disturbed. *Strobilanthes*, if present, will require special treatment, measures for dealing with which have been suggested in paragraph 357. During the operation of clearing the gap, damaged saplings and seedlings of useful species should be cut back, and regeneration if any, should be freed.

406. *Staking.*—The normal espacement will be $4\frac{1}{2}' \times 4\frac{1}{2}'$, unless or until experience indicates that some other spacing is preferable. Stakes will be planted firmly at these intervals, which can be gauged by eye without careful measurement. If the vegetation in the gaps has been considerably disturbed or destroyed temporarily in the process of felling and extraction, regular espacement is unessential and advantage should rather be taken of shrub-growth as much as possible to provide side shade during the first year or two until plants are established. The staking will be carried into the surrounding forest for a distance of five or six yards around the margin of the gap.

407. *Species.*—Choice of species to be raised at each gap is left to the District Forest Officer. *Artocarpus hirsuta* is a species likely to succeed in the centre of gaps, especially in moist deciduous and transitional surroundings. In evergreen forest very good results have been obtained from seed, whereas in deciduous forest the seeds and young plants have been frequently attacked by vermin. Where the latter circumstances are feared or anticipated, one year old nursery transplants should be tried. Previous experiments in this division with one year old stumps of *Artocarpus* have proved unsuccessful, but considerable success has been achieved by the Provincial Sylviculturist in the use of three-year old stumps of this species. These should also be tried ; if they are not available in the first two years of the currency of this plan, the oldest that can be obtained should be used as stumps up to three years of age. *Hopea parviflora* is the most reliable species for sowing around the edges of the gap and under shelter of the surrounding forest. Experiments with *Mesua ferrea* and *Cedrela Toona*, both by sowing and by nursery transplants, should be made, such having been eminently successful in the Tinnevelly evergreens. *Acrocarpus fraxinifolius* and *Swietenia macrophylla* are other species to be experimented with, more particularly where prolific weed-growth and transitional types of vegetation are evident. The Provincial Sylviculturist should be periodically consulted on the results of his experiments elsewhere in the regeneration of evergreen species.

408 *Sowing and planting.*—The soil at stakes should be loosened during May to a depth of ten inches. Sowing should be completed by the 7th June. In years of prolific seedfall of desirable species, broadcast sowing can be tried. The general rules for sowing and planting are identical with those given in paragraphs 368—371.

Replacement of casualties, weeding and tending (deciduous and evergreen species).

409. *Casualties.*—Casualties at stakes will be replaced as usual during the first growing season as they occur, and in the second growing season by stumps or one year old nursery transplants according to the species introduced.

410. *Weeding and tending.*—No special programme for tending regeneration in gaps is provided, apart from that laid down in the tabular statement of operations for the whole coupe. The management will accommodate itself to any special circumstances arising which cannot at present be foreseen. The importance of securing a full stocking in the gaps during the first year is emphasised. Soil-working along with the weeding will need to be considered in the case of deciduous species, particularly teak. Mamooty scraping for the full distance between teak seedlings should be tried, and continued if successful and not prohibitive in cost. In the case of *Dalbergia latifolia* weeding should be given during the first year, but subsequently only the heads need be kept free. In the case of modified light demanders and evergreens, overcrowding and suppression by competing growth should be prevented. Climber-cutting will be done along with the weedings, and as necessary at subsequent intervals by the beat guard.

E. Experiments in regeneration.

411. Experiments on a small scale are to be carried out on the following lines, each year for the next five years unless a shorter period is prescribed and the results carefully watched and recorded.

412. (*a*) *Sowing of Hopea without aligning and staking.*—A small experiment in Kanakamajalu reserve conducted on these lines having shown very satisfactory results, the method should be adopted experimentally in future alongside of areas pitted, aligned and staked in the normal prescribed fashion but otherwise identical in situation and vegetational characteristics, so that proper comparison of costs and subsequent results may be readily observed. The method should be considerably cheaper, and will give denser stocking. It is only to be adopted in localities which are entirely suited to Hopea, and preferably where the soil is soft and permeable. The method is brifly as follows :—

Coolies provided with hard pointed stakes or with mamooties are told off at regular intervals of (say) 20 yards across the area, so that each has a separate strip or task to perform. They will be given a sufficient number of Hopea seeds to sow up their individual strips. They will then proceed through the forest in more or less straight lines, stopping at every 4 feet interval, where they will lightly clear the ground of surface vegetation in a space of about one foot radius and break up the soil to a depth of 4 to 6 inches, but without digging regular pits. About six seeds will be distributed at each patch and covered with a thin surface layer of soil. No regular espacement is essential. The work while in progress will require close supervision and every task must be inspected and passed by the forester in charge of the operation, before the coolies are allowed to depart elsewhere. It is important that strips should be clearly defined and that no space be left unsown between adjoining strips unless they are unsuitable. The areas so regenerated will be surveyed and indicated on the large scale regeneration maps for future identification.

413. (*b*) It has been observed in many localities that moist semi-blank areas containing grass and small trees or scrub can be most readily regenerated with Hopea and *Artocarpus hirsuta* if seeds of these species are dibbled in the same manner as sandal is sown, i.e., in the shade of existing vegetation. Overhead shade is essential, but the plants may be quite exposed to light at the sides. Seedlings thus sown often show exceptionally vigorous growth and generally surpass at an early age those sown under the denser shade of several canopies. Uniform espacement is however useless in such cases, and should never be attempted. Judicious choice of each locality is necessary and seeds should be sown on the northern or north-easterly sides of bushes and small trees.

414. (*c*) *Broadcast sowing.*—In the next two good seed years for Hopea (whether or no regular working of reserves is by then undertaken), an experiment will be tried in the regeneration of a coupe by broadcast sowing of Hopea. The coupe should be chiefly of the moist deciduous and semi-evergreen type. The District Forest Officer or a gazetted assistant shall personally select specially suitable patches within the coupe. The patches may be of any size up to half an acre in extent, and the aggregate area of the patches should be about quarter of the total area of the coupe, (or of that portion of it which has no natural advance growth of valuable species on it). Strips or narrow belts instead of compact patches may be sown at the discretion of the District Forest Officer. The coupe selected should be one which will be felled for the first time within a period of five years of the date of sowing. A dense undergrowth and middle-storey is not essential for success, but the areas selected should be moist, and there should be a good and tolerable dense top storey, preferably at not less than 30 feet height. All undergrowth should be cut back so that it is no more than one foot above ground level. A good germinating soil must be exposed by sweeping off any accumulation of undecomposed litter. Seed will be sown broadcast over the prepared patches during the early rains at the end of May or early in June. The patches will be tended both before and after felling, according to the discretion of the District Forest Officer. If successful, it is thought very probable that tending and climber-cutting can be substantially reduced, as compared with the normal staked and aligned regenerated areas, after the first few years. This appears to be the case in all broadcast sown plots in the past.

Fellings will be conducted so that trees are thrown clear from the regenerated patches as far as possible. The reduction of canopy will necessarily be gradual, but owing to the self-protecting qualities of a Hopea thicket, it may be accelerated beyond the normal rate of removal. While it is preferable that high canopy be retained during early stages rather than the middle storey, mature standing timber over the regenerated patches should be removed before the young crop has advanced too far in the woody saplings stage, whereafter the damage caused by fellings will be greater than is desirable.

As regeneration by the above means is only experimental and the results will not be clear for 10 years, it should be remembered that in case of failure, other methods will have to be prescribed for the regeneration of the coupe. The intention of the experiment

is to determine if patches when broadcast-sown can be established more quickly and at less expense than by normal methods ; and to what extent the patches thus established will in due course serve as nuclei for the natural spread of this species throughout the remainder of the coupe during the course of the first period. The patches will be numbered, their approximate area estimated, and their location entered on the regeneration map. The costs of the several items will be carefully kept, and a running account of the operations maintained in the Control Journal.

415. *Experiments in controlled burning.*—There are certain deciduous compartments (e.g., in Mujur Block) wherein owing to fire protection, a fairly heavy ground flora has successfully ousted natural regeneration of deciduous species, while yet the understorey of small evergreen trees is inadequately developed to ensure safe regeneration by an evergreen crop of Hopea. It is possible that the treatment most suited for such compartments in order to induce natural regeneration of deciduous species should be one not dissimilar from that practised in certain Sal forests and in Assam, where like conditions prevail. It is therefore prescribed as an experiment that in Mujur coupe ii (felled in 1930-31) and in the next two coupes to be felled in the future, a plot of about four acres should be selected by the District Forest Officer in which regeneration of deciduous species is sparase or lacking owing to the conditions described above. These will contain such undergrowth as *Webera, Strobilanthes, Glycosmis,* etc. The undergrowth will be cut in the first instance in about the month of December, and burnt fairly late in the following hot weather, so that the scanty material will burn properly. Heaping of the cut material is not desirable, since the object of the burn is to destroy the living undergrowth all over the area. This is unlikely to be achieved in one single operation which will probably need to be repeated once or twice more. It is suggested that this be done at 2—3 year intervals, but this is left to the discretion of the management. As the amount of undergrowth decreases and its place is taken by grass or other lighter growth, the burn can be started earlier in the season and cutting need not be resorted to. In the case of a *Xylia* area, two light burns, or even one may have sufficiently satisfactory results in the removal of undesirable weeds and stimulation of root-suckers and seed-germination. Where *Terminalias* and other species are concerned an additional burn may be necessary. Trenching and root-wounding may also be used supplementarily as prescribed in pargraph 356. The necessary precautions must of course be taken to prevent the spread of the fire into surrounding forest. It is preferable that the first burn—except in the case of coupe ii of Mujur—be made two years before felling. What is required is (i) the prevention of a return to evergreen conditions, and (ii) the production of conditions favourable to the appearance of natural regeneration of deciduous species. *Directly* these conditions appear to be fulfilled, the plots should be rigidly fire-protected. After each burning operation is over, advance-growth of useful species damaged but not killed outright by the burn should be cut back to ground-level, leaving a clean slanting cut surface. If the above operations are a success, the method can be used on a larger scale. If burning alone—without supplementary removal of shade—is not productive of entirely satisfactory results, canopy may be reduced by the felling of understorey or unsaleable trees, but it is not intended that this should be done beyond the degree which would be practicable under normal circumstances in the regeneration of the forest upon lines already laid down. *In burnt areas artificial gap regeneration should not be resorted to.* In order to test results on a quantitative basis, an " indicator plot " of ½ acre extent should be measured out and demarcated with small cairns in each burnt area. A similar plot will be laid out in the adjacent (unburnt) forest. All useful seedlings and rootsuckers will be pegged, numbered and recorded at the beginning of the experiment, and at three yearly intervals subsequently.

416. Observations in the natural forest, and also from occasional experiments in the past, lead to the conclusion that even in evergreen forest the temporary destruction of undergrowth by burning provides a more satisfactory germinating bed for seeds such as Hopea and *Artocarpus* than an undisturbed floor. In evergreen forest the limiting condition is often that of too intense shade at ground-level. An experiment will therefore be started by the District Forest Officer where advance-growth under parent trees of Hopea and *Artocarpus hirsuta* is sparse or lacking with the object of widening natural regeneration of these species by controlled burning. A plot of about ½ acre should be marked out and the undergrowth cut down to ground level early in November. It will be burnt before the end of March. Seedlings which appear in each of the following three years will be pegged, numbered and recorded. A control plot adjacent to the experimental plot should also be demarcated ; existing seedlings should be pegged and numbered in the same way, and enumerations conducted subsequently concomitantly with those in the experimental plot. It is a matter to be decided whether the cost of such an operation is in any way commensurate with results, and also whether a mere cutting of the undergrowth in the first instance will give results as good or better, without the necessity for burning. If results from

the first experiment in 1933 are indeterminate, the experiment should be again repeated. The Provincial Sylviculturist may be consulted.

Section 3.—Other Subsidiary Operations.

Note.—The following prescriptions, although necessary for the correct conduct of sylvicultural measures to benefit crops in this working circle, have at the present time, more particular application to plantations of Hopea, etc., under shelterwood, which are dealt with under the Working Plan for the Plantation Working Circle.

(A) Removal of overhead shade from established Hopea seedlings (3 *feet high and above*).

417. A marking shall first be made in the trees constituting the overwood. This will be a sylvicultural marking, having the secondary object of deriving revenue from all saleable trees. This thinning of the overwood is to be sharply differentiated from "crown thinnings" or "increment felling." It is to be remembered that the retention of large sized trees in the upper canopy for purposes of increment until the young Hopea crop has advanced well into the young pole stage is inadvisable on account of the greater damage by breakage likely to be caused by their fall. Fellings for the sake of revenue should therefore be confined as far as possible to early operations, since scope for the realization of revenue will be more limited during subsequent fellings. In general, it is best to leave the least valuable individuals for shade purposes, so that many of these may be girdled at the next operation without sacrifice of revenue or of the young crop.

418. Trees in the following categories will be removed in the first operation :—

(i) Good merchantable stems, the retention of which is not desirable or essential for shade purposes. Minimum girth limits are not prescribed for this operation since the young crop was originally formed under varying conditions and ages of the overwood. They should therefore be fixed by the District Forest Officer, having regard *chiefly* to the requirements of the young crop.

(ii) Subdominant, suppressed or malformed stems of saleable value, which have no future in the crop.

(iii) Dominating trees of non-merchantable species, in groups of trees wherein the removal of the above two categories (i) and (ii) has not adequately opened the canopy.

(iv) Overmature trees, stems which are unsound or attacked by fungus and ficus-bound trees, should be removed if they directly interfere with the progress of the young crop, but *not* if excessively destructive of canopy or too costly to remove.

The avoidance of large gaps in the top canopy by too intensive felling is of paramount importance ; uniformity of opening is desirable. This work cannot be safely left to a subordinate under the rank of an experienced Ranger, who should closely supervise all marking. The work must be inspected and passed by the District Forest Officer, or a gazetted assistant.

419. The middle storey of evergreen trees should be marked for fellings or girdling after the previous operation is completed. A very experienced marking officer might be able to perform the operations simultaneously, but this course is not recommended, as it is difficult to pay due attention to both storeys at one and the same time. The operation should be done at a time when the deciduous trees of the overwood are not in leaf. Marking should be *light* in the following instances :—

(*a*) On hot slopes of southerly aspect ;

(*b*) when the upper canopy contains stunted or poorly-grown trees, and the leaf canopy is poor ;

(*c*) in gaps caused by felling in the over-wood ; these inevitably cause some damage to the middle storey, however judiciously accomplished ;

(*d*) where Hopea seedlings are less than 2 feet high.

Marking will be *heavier* in the following instances :—

(*a*) on cool slopes of northerly or easterly aspects ;

(*b*) when the overwood contains tall, straight well-favoured trees ;

(*c*) where the overwood is allowed to remain comparatively undisturbed ;

(*d*) where the undergrowth contains thick-leaved, stocky species such as *Webera* ;

(*e*) where the young crop has reached the sapling stage of 6 feet height or over.

It is not necessary to lay down any rigid rules for invariable application, common sense being the sole guide in individual circumstances. No limits of girth, height, or distance away from Hopea seedlings can be universally adopted. In those compartments where the Hopea was given a wide espacement of 13 feet or 27 feet by 27 feet it is unnecessary to remove more of the middle storey than directly concerns the young crop of Hopea, but where casualties and blanks have occurred, effort will be made to free seedlings and advance-growth of other saleable timber species wherever they are found. On cool, northerly slopes where the sun's rays strike transversely, it should be remembered that trees not directly above, but generally on the upper contours, are responsible for shutting out most of the

light. In the majority of cases, however, the ideal for fully established seedlings and young plants of Hopea and *Artocarpus* is for their heads to be entirely free and accessible to light from vertically overhead, while side shade is retained in due and necessary degree by foliage in the upper canopy, supplemented as far as necessary by evergreen foliage from the understorey during hot-weather months. The narrower and 'taller' the gaps the better is the effect in drawing up the young plants. Low overhanging shade is detrimental as a rule.

420. A climber-cutting shall be performed throughout the compartment at the same time as the marking. This refers to climbers which have invaded the upper storeys, not to the young crop, which is tended under separate prescriptions (vide paragraph 422).

(*B*) *Felling and Extraction.*

421. The ordinary felling rules under paragraph 339 will be observed. Discretion will be left to the management regarding the middle storey, whether this be felled or merely girdled. This operation is best performed after extraction of the saleable species, or when the extent of breakage caused thereby can be ascertained. Small evergreen trees, such as *Aporosa Lindleyana,* frequently coppice strongly ; they should be felled well below the heads of neighbouring seedlings, and the stems hacked so as to minimise the growth of coppice-shoots. If the removal of overhanging branches is all that is really necessary in order to free the young plants, this may be done in preference to complete felling of the tree, provided that the operation can conveniently be performed.

422. *Subsequent tending of the young crop.*—Immediately after felling and conversion, a search will be made to liberate all seedlings which may have become obscured by debris, which should be piled well away from them. Before the following growing season has well started, i.e., before the first showers at the latter end of May, damaged seedlings shall be cut back, double leaders pruned, and a climber cutting done, together with weeding to the extent necessary.

423. *Further fellings in the upper shade canopy.*—No precise date for subsequent removal of top shade can be laid down, the intervals being dependant on the state of advancement and requirements of the young crop in each individual case. It is *prescribed* however, that the District Forest Officer shall personally inspect the crop throughout the coupe five years after the first operation described above, and shall note the circumstances in the Control Journal. He shall state whether he considers further removal necessary, or whether the compartment is to remain as it is for a further period ; in the latter case he should lay down a *definite date* when further inspection is desirable, and should order any interim attention which he considers necessary in the interests of the crop. As far as possible, girdling will be performed in preference to felling, but all saleable stems which can safely be removed will be extracted, great care being taken while directing the fellings. Medium-sized trees with overhanging crowns shall have their upper branches lopped prior to felling, if damage to neighbouring Hopea poles is feared. While an appreciable middle storey still exists, it is preferable to limit fellings after the first five years primarily to such trees, felling in the top storey only to the minimum degree actually necessary.

424. To summarize, the principles to be followed are—

(i) Once the young crop has been established, all subsequent considerations are subsidiary to its welfare.

(ii) Extraction of the overwood should be performed, *firstly* in order to encourage height-growth in the young plants, *secondly* that they should put on girth and strong woody growth in the stems in order to secure them against accidents. Fellings of the overwood should therefore be made *chiefly* during early stages, when the plants are pliant and susceptible to treatment, and subsequently only when they have reached such strength and vigour as to enable them to withstand or avoid breakage altogether. No experience has yet been gained in the final removal of the old crop ; it is probable that given vertical space for development of the Hopea, it will in due course overtop the remaining deciduous trees, which can then be removed (if desirable) without further danger.

(iii) The *degree* of removal of top shade will depend on—

(*a*) the vigour of the young plants in overtopping competing growth,

(*b*) the original espacement of the crop.

(iv) It is safer to operate conservatively and often, than heavily and at wide intervals of time.

Cleanings and thinnings in Hopea crops.

425. (i) *Cleanings.*—At every quinquennial inspection previously prescribed in paragraph 345 for regenerated compartments, the District Forest Officer shall make note of first class areas of natural regeneration wherein the young crop is sufficiently advanced in

the thicket stage to benefit by a cleaning. The object of the cleaning is to benefit individuals of the future by reduction of surrounding root competition, mechanical damage, and possible risk of insect infection. All noxious growth, climbers and dominant but badly-formed Hopea plants will be cut back. Diseased plants, if any, will be uprooted. Stout thrifty specimens are to be encouraged rather than tall, spindly straggling ones. The essential close formation of the crop is not to be destroyed, however, under any circumstances, and a complete covering of the ground by tree species is to be aimed at. Where Hopea is not present the order of preference given in paragraph 387 is to be followed.

426. (ii) *Thinnings in natural Hopea areas.*—In a few compartments pole crops are undoubtedly too close for maximum progress. A great deal of unnecessary competing growth, both of *Hopea parviflora* and of inferior species is present, making for untidy and badly formed habit. Operations in these compartments shall have as their principal object the favouring of those poles about to enter the top canopy, but all stages down to sapling growth of desirable species (not only Hopea) should be afforded such attention as to allow them vertical freedom for development. The natural forest should be cleaned of unnecessary and impeding growth in the lower storeys so as to ensure that all straight young poles and saplings likely at some time or other to form part of the final crop will develop unhindered. Undesirable occupants in the dominating stages should be deeply girdled. Climbers will be cut. Some revenue may be derived from the felling and conversion of oversized trees which it is desirable to remove on sylvicultural grounds. Expenditure should be limited to the necessary minimum.

Fellings in compartments not in the Regeneration Area (all felling series).

427. *Fellings to realize mature and over-mature timber.*—The retention is contemplated under the present system of management, of exceptionally sound and vigorous stems where desirable, for a period beyond the normal rotation in order to secure first quality timber of large dimensions of species such as *Dalbergia latifolia, Tectona grandis, Terminalia tomentosa, Artocarpus hirsuta*, etc., if special markets can be found for them (vide paragraph 312). For this reason, removal of timber in the future from compartments not included in the Regeneration Area is permissible. The prescribed minimum girth-limits for such fellings are 9 feet for deciduous species and 12 feet for evergreen species at breast-height or above buttresses.

428. *Improvement fellings to benefit older crops.*—Improvement fellings are also permitted, but not definitely prescribed, where the management desire to realize timber of saleable value which will suffer by being left until the compartment is regenerated in the normal course. These fellings will also benefit the remainder of the crop by affording enhanced growing-space. Fellings of this nature have been undertaken during the current year (1931), in Mandekole reserved forest. Although primarily for the sake of revenue, and also, as occasion may arise, in order to supplement the normal yields from coupes under regeneration, it is to be distinctly understood that such fellings apply only to over-mature or unsound stems which cannot survive or put on a desirable increment during the period requisite for the bulk of the crop in the compartment to attain exploitable dimensions and come under regeneration. No girth-limits of extraction need be defined for these operations, but the District Forest Officer, shall submit precise proposals to the Conservator in the year prior to any projected fellings of this nature, and will secure his approval thereto. The intensity of such fellings should never exceed that of a "light crown thinning" and it is essential that no gaps in the canopy should be so large as to be of permanent duration.

During the period for which the present plan will remain in force, improvement fellings made primarily with the object of benefiting immature pole-crops in compartments outside the regeneration area are not prescribed for this Working circle. The bulk of deciduous crops of the present rotation, being immature secondary regrowth from kumri, are not, as a rule, of adequate importance or value to warrant expense on improvement operations without some net profit accruing from the sale of timber extracted. In the majority of cases a proper conduct of the operations would very doubtfully fulfil the above condition in the present state of the market, while if undertaken there would be a strong temptation to make the operations pay by a somewhat cursory application of essential principles. The finances of the division will not permit of unremunerative works without they possess very obvious advantages to future crops. The question will be further considered at the next revision of the working plan.

429 *Tabular Statement of Operations—(A) According to locality.*

Name of block.	Compartment number.	Coupe number.	Area in acres.	Year of operation.	Nature of operation.	Remarks.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
					KASARAGOD FELLING SERIES.	
					(i) Partially regenerated group.	
Aletti West (Devakaje).	3	..	272	1932–33 ..	Tending by beat guard.	Coupes felled in 1928–30. (Partly regenerated.)
				1933–34 ..	Re-girdling or felling in middle-storey as necessary. Freeing older seedlings.	
				1934–35 ..	Tending and climber-cutting by beat guard.	
				1935–36 ..	Survey and re-classification of regeneration. Inspection by District Forest Officer.	
				1936–40 ..	Tending, shade-reduction, etc., as ordered by District Forest Officer.	
Aletti East (Karlekadu).	2	..	36	1932–33 ..	Nil.	Felled in 1930–31.
				1933–34 ..	Freeing natural regeneration and climber-cutting.	
				1934–35 ..	Climber-cutting; shade-reduction in middle-storey as necessary.	
				1935–36 ..	Survey and re-classification of regeneration.	
				1936–37 ..	Inspection by District Forest Officer.	
				1937–40 ..	Tending, shade-reduction, etc., as ordered by District Forest Officer.	
Aletti East (Chonapadimalai).	2	..	65	1932–33 ..	Clearing inspection paths. Shade-reduction in middle-storey as necessary. Tending natural regeneration. Artificial sowings—Classes (iii) —(iv)—maximum 22 acres.	Felled in 1931–32.
				1933–34 ..	Replacement of casualties in sown areas. Cleaning and tending of natural regeneration.	
				1934–35 ..	Cleaning and climber-cutting.	
				1935–36 ..	Nil.	
				1936–37 ..	Survey and re-classification of regeneration. Inspection by District Forest Officer.	
				1937–40 ..	Tending, shade-reduction, etc., as ordered by District Forest Officer.	
Sampaje (Kunithodu).	1	..	51	1932–33 ..	Nil.	Felled in 1928–29.
				1933–34 ..	Artificial regeneration of blanks in deciduous areas. Sowing of Hopea and *Artocarpus* in moist areas. Tending natural regeneration.	Artificial regeneration not to exceed 12 acres.
				1934–35 ..	Weeding and tending of artificial regeneration. Inspection by District Forest Officer.	
				1935–41 ..	As ordered by District Forest Officer.	
					(ii) Group to be regenerated.	
Sampaje (Bantwadi).	4	I	82	1936–37 ..	Marking for felling.	
				1937–38 ..	First regeneration felling and extraction.	
				1938–39 ..	Inspection paths. Tending natural regeneration. Artificial regeneration of gaps.	
				1939–40 ..	Replacement of casualties; weeding in gaps. Tending natural regeneration.	
				1940–41 ..	Cleaning and tending.	
Sampaje (Bantwadi).	4	II	102	1937–38 ..	Marking for felling; advance fellings.	
				1938–39 ..	First regeneration felling and extraction.	
				1939–40 and 1940–41.	Annual operation in order prescribed for Coupe I.	
Sampaje (Baile)..	7	III	50	1938–39 ..	Marking for felling; advance fellings.	
				1939–40 ..	First regeneration felling and extraction.	
				1940–41 and 1941–42.	Regeneration works as prescribed for Coupe I (1939–41).	
Sampaje (Baile).	7	IV	73	1930–40 ..	Marking for felling; advance fellings.	
				1940–41 ..	First regeneration felling and extraction.	
				1941–42 ..	Regeneration works.	
Sampaje (Kanalethodu).	7 & 8	V	48	1940–41 ..	Marking for felling; advance fellings.	
				1941–42 ..	First regeneration felling and extraction.	
Sampaje (Kanalethodu).	7	VI	48	1941–42 ..	Marking for felling.	
					PUTTUR FELLING SERIES 'A.'	
					(i) Partially regenerated group.	
Nalkur (Katmarabetta).	1	..	1,106	1932–33 ..	Regeneration survey and re-classification.	Felled in 1925–30.
				1933–34 ..	Cleaning in Class (i) areas; re-clearing lines in Class (ii); staking and weeding 500 plants per acre in Class (iii) with supplementary sowings; artificial regenerarion of gaps in Class (iv) where necessary.	
				1934–35 ..	Weeding and replacement of casualties in Class (iv).	
				1935–36 ..	Nil.	
				1936–37 ..	Light tending and climber-cutting; reduction of low shade where necessary.	
				1937–38 ..	Inspection by District Forest Officer.	
				1938–39 to 1941–42.	Further tending as ordered by District Forest Officer.	

Name of block. (1)	Compartment number. (2)	Coupe number. (3)	Area in acres. (4)	Year of operation. (5)	Nature of operation. (6)	Remarks. (7)
					PUTTUR FELLING SERIES 'A'—*cont.*	
					(ii) Group to be regenerated.	
Nalkur	2	I	191	1932–33 ..	(a) Regeneration survey; (b) clearing inspection paths; (c) cleaning in Class (i) areas; (d) re-clearing lines in Class (ii) areas; (e) artificial regeneration of gaps in Class (iv) areas.	Felled in 1931–32.
				1933–34 ..	Staking of 500 plants per acre in Class (iii) areas with supplementary sowings. Weeding and climber-cutting in Classes (i) to (iv); replacement of casualties in Class (iv) areas.	Artificial regeneration not to exceed 48 acres.
				1934–35 ..	Nil.	
				1935–36 ..	Weeding and climber-cutting, classes (i) to (iv).	
				1936–37 ..	Tending by beat guard.	
				1937–38 ..	Re-survey and re-classification of regeneration.	
				..	Inspection by District Forest Officer.	
				1938–41 ..	Reduction of low shade and further tending under orders of District Forest Officer.	
Jalsur East ..	3	II	189	1932–33 ..	Regeneration survey.	
				1933–34 ..	Preparatory regeneration works over Hopea advance-growth.	A moist deciduous locality with Hopea and *Xylia* regeneration but sleeper-yield small.
				1934–35 ..	Nil.	
				1935–36 ..	Nil.	
				1936–37 ..	Marking for felling.	
				1937–38 ..	Regeneration felling and extraction.	
				1938–39 ..	Inspection paths; freeing advance-growth; artificial regeneration of Hopea in selected patches; reduction of low shade where necessary.	
..					Artificial regeneration in gaps.	*Artocarpus* should be tried in gaps.
				1939–40 ..	Weeding and climber-cutting; replacement of casualties in sown areas.	
				1940–41 ..	Weeding and climber-cutting.	
				1941–42 ..	Tending by beat guard.	
Nalkur	2	III	182	1934–35 ..	Regeneration survey. Preparatory regeneration works.	Advance fellings to be adjusted so that there is no break in sleeper supply after unreserves are exhausted.
				1935–36 ..	Nil.	
				1936–37 ..	Preparatory works if neccessary.	
				1937–38 ..	Marking for felling; advance fellings.	
				1938–39 ..	First regeneration felling and extraction.	
				1939–40 ..	(a) Clearing inspection paths; (b) tending natural regeneration in Classes (i) to (iii); (c) artificial regeneration, Classes (iii) and (iv); (d) reduction of low shade.	Artificial regeneration not to exceed 48 acres.
..				1940–41 ..	(a) Weeding and climber-cutting, Classes (i) to (iv); (b) replacement of casualties in sown areas.	
				1941–42 ..	Nil.	
Nalkur	2 4	IV-*a* IV-*b*	105 87	1935–36 ..	Regeneration survey and classification. Preparatory regeneration works over Hopea advance growth.	
				1936–37 ..	Nil.	
				1937–38 ..	Preparatory works if necessary.	
				1938–39 ..	Marking for felling; advance fellings.	
				1939–40 ..	Regeneration felling and extraction.	
				1940–41 ..	Inspection paths; freeing advance-growth; cleaning in Class (i) areas; cutting lines, Class (ii) areas; staking 500 seedlings per acre, Class (iii) areas with supplementary sowings; artificial regeneration of gaps, Class (iv) areas.	Artificial regeneration not to execeed 48 acres.
				1941–42 ..	Weeding and climber-cutting. Replacement of casualties, Class (iv) areas.	
Nalkur	..	V	206	1936–37 ..	Regeneration survey and classification. Preparatory regeneration works.	
				1937–38 ..	Nil.	
				1938–39 ..	Preparatory works if necessary.	
				1939–40 ..	Marking for felling; advance fellings.	
				1940–41 ..	Regeneration felling and extraction.	
				1941–42 ..	Inspection paths and regeneration works.	
Nalkur	..	VI	168	1937–38 ..	Regeneration survey and classification. Preparatory regeneration works.	
				1938–39 ..	Nil.	
				1939–40 ..	Preparatory works if neccessary.	
				1940–41 ..	Marking for felling; advance fellings.	
				1941–42 ..	Regeneration felling.	
Nalkur	..	VII	210	1938–39 ..	Regeneration survey and classification. Preparatory regeneration works.	
				1939–40 ..	Nil.	
				1940–41 ..	Preparatory works if necessary.	
				1941–42 ..	Marking for felling.	
Aranthakallu ..	1	VIII	101	1939–40 ..	Regeneration survey and classification. Preparatory regeneration works.	
				1940–41 ..	Nil.	
				1941–42 ..	Preparatory works if necessary.	
Aranthakallu ..	2 & 3	IX	84	1940–41 ..	Regeneration survey and classification. Preparatory regeneration works.	
				1941–42 ..	Nil.	
Aranthakallu ..	3	X	86	1941–42 ..	Regeneration survey and classification. Preparatory regeneration works.	

Name of block.	Compartment number.	Coupe number.	Area in acres.	Year of operation.	Nature of operation.	Remarks.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
					PUTTUR FELLING SERIES 'B.'	
Bantamale Reserved Forest.	2	I	97	1933–34 ..	Regeneration survey. Preparatory regeneration operations.	
				1934–35 ..	Nil.	
				1935–36 ..	Preparatory regeneration operations if necessary.	
				1936–37 ..	Marking for felling.	
				1937–38 ..	First regeneration felling and extraction.	
				1938–39 ..	(a) Weeding and cleaning in Class (i) areas. (b) Re-clearing lines in Class (ii) areas. (c) Staking and weeding 500 seedlings per acre in Class (iii) areas. (d) Artificial regeneration of gaps in Class (iv) areas. (e) Reduction of low shade where necessary.	Maximum area to be artificially regenerated 24 acres—vide paragraph 431.
				1939–40 ..	(a) Weeding and climber-cutting in Classes (i) to (iv.) (b) Replacement of casualties in Classes (iii) and (iv).	
				1940–41 ..	Nil.	
				1941–42 ..	Cleaning and climber-cutting as necessary, classes (ii) to (iv), by beat guard.	
Bantamale Reserved Forest.	2	II	68	1934–35 ..	Regeneration survey. Preparatory regeneration operations.	
				1935–36 ..	Nil.	
				1936–37 ..	Preparatory regeneration operations if necessary.	
				1937–38 ..	Marking for felling.	
				1938–39 ..	First regeneration felling and extraction.	
				1939–40 ..	(a) Weeding and cleaning in Class (i) areas. (b) Re-clearing lines in Class (ii) areas. (c) Staking and weeding 500 seedlings per acre in Class (iii) areas. (d) Artificial regeneration of gaps in Class (iv) areas. (e) Reduction of low shade as necessary.	Maximum area for artificial regeneration 17 acres—vide paragraph 431.
				1940–41 ..	(a) Weeding and climber-cutting in Classes (i) to (iv). (b) Replacement of casaulties in classes (iii) and (iv).	
				1941–42 ..	Nil.	
Bantamale Reserved Forest.	2	III	92	1935–36 ..	Regeneration survey and classification.	
				1936–37 ..	Nil.	
				1937–38 ..	Preparatory operation if necessary.	
				1938–39 ..	Marking for felling.	
				1939–40 ..	First regeneration felling and extraction.	
				1940–41 ..	Inspection paths ; weeding and tending natural regeneration ; artificial regeneration in Classes (iii) and (iv) ; reduction of low shade.	Maximum area to be regenerated —23 acres.
				1941–42 ..	Weeding and climber-cutting, Classes (i) to (iv). Replacement of casualties, Classes (iii) and (iv).	
Bantamale Reserved Forest.	1 & 2	IV	90	1936–37 ..	Regeneration survey and classification. Preparatory regeneration operation.	
				1937–38 ..	Nil.	
				1938–39 ..	Preparatory operation if necessary.	
				1939–40 ..	Marking for felling.	
				1940–41 ..	First regeneration felling and extraction.	
				1941–42 ..	Inspection paths ; weeding and tending natural regeneration ; artificial regeneration in Classes (iii) and (iv) ; reduction of low shade.	Maximum area to be regenerated —23 acres.
Bantamale Reserved Forest.	1	V	96	1937–38 ..	Regeneration survey and classification. Preparatory regeneration operations.	
				1938–39 ..	Nil.	
				1939–40 ..	Preparatory operations as necessary.	
				1940–41 ..	Marking for felling.	
				1941–42 ..	First regeneration felling and extraction.	Maximum area to be regenerated —23 acres.
Devachalla Reserved Forest.	4	VI	79	1938–39 ..	Regeneration survey and classification. Preparatory regeneration operations.	Maximum area to be artificially regenerated 20 acres.
				1939–40 ..	Nil.	
				1940–41 ..	Preparatory operations if necessary.	
				1941–42 ..	Marking for felling.	
Bantamale Reserved Forest.	2	VII	108	1939–40 ..	Regeneration survey and classification. Preparatory regeneration operations.	
				1940–41 ..	Nil.	
				1941–42 ..	Preparatory operations if necessary.	
Bantamale Reserved Forest.	2 & 3	VIII	99	1940–41 ..	Regeneration survey and classification. Preparatory regeneration operations.	
				1941–42 ..	Nil.	
Bantamale Reserved Forest.	2 & 3	IX	102	1941–42 ..	Regeneration survey and classification. Preparatory regeneration operations.	
					UPPINANGADY FELLING SERIES.	
					(i) *Partially regenerated group.*	
Mujur Reserved Forest.	1	XIV	160	1932–33 ..	Cleaning and tending.	Felled—1930-31.
				1933–34 ..	Nil.	
				1934–35 ..	Cleaning and tending.	
				1935–36 ..	Inspection by District Forest Officer.	
				1936–40 ..	Attention as ordered by District Forest Officer.	

Name of block.	Compartment number.	Coupe number.	Area in acres.	Year of operation.	Nature of operation.	Remarks.
(1)	(2)	(3)	4)	(5)	(6)	(7)
					UPPINANGADI FELLING SERIES—*cont.*	
Mujur Reserved Forest.	1	XV	114	1932–33 ..	Inspection paths. Tending of natural regeneration. Artificial regeneration of gaps and under shelterwood.	Felled in 1931–32.
				1933–34 ..	Weeding and tending. Replacement of casualties.	
				1934–35 ..	Cleaning and tending.	
				1935–36 ..	Inspection by District Forest Officer.	
				1936–37 to 1939–40 ..	Attention as ordered by District Forest Officer.	
					(ii) *Group to be regenerated.*	
Mujur Reserved Forest.	13	I	83	1936–37 ..	Preparation of suitability map. Marking for felling.	
				1937–38 ..	Regeneration felling and extraction.	
				1938–39 ..	Weeding and tending of natural regeneration. Supplemental artificial regeneration. Inspection paths.	
				1939–40 ..	Weeding and tending; replacement of casualties.	
				1940–41 ..	Weeding and tending.	
				1941–42 ..	Inspection by District Forest Officer. Attention as ordered by District Forest Officer.	
Mujdr Reserved Forest.	13	II	72	1937–38 ..	Preparation of suitability map. Marking for felling.	
				1938–39 ..	Regeneration felling and extraction.	
				1939–40 ..	Inspection paths; tending of natural regeneration; supplemental artificial regeneration of gaps and under shelterwood.	
				1940–41 ..	Weeding and tending; replacement of casualties.	
				1941–42 ..	Cleaning.	
Mujur Reserved Forest.	13	III	96	1938–39 ..	Preparation of suitability map. Marking for felling.	
				1939–40 ..	Regeneration felling and extraction.	
				1940–41 ..	Inspection paths; tending of natural regeneration. Supplemental artificial regeneration.	
				1941–42 ..	Weeding and tending; replacement of casualties.	
Mujur Reserved Forest.	13	IV	80	1939–40 ..	Preparation of suitability map. Marking for felling.	
				1940–41 ..	Regeneration felling and extraction.	
				1941–42 ..	Inspection paths; tending of natural regeneration; supplemental artificial regeneration.	
Mujur Reserved Forest.	12	V	88	1940–41 ..	Preparation of suitability map. Marking for felling.	
				1941–42 ..	Regeneration felling and extraction.	
Mujur Reserved Forest.	12	VI	76	1941–42 ..	Preparation of suitability map. Marking for felling.	

430. (*B*) *According to years—*

Kasaragod Felling Series.

Year.	Locality.	Nature of operation.
1932–33 ..	Aletti West, Compartment 3 (Devakaje).	Tending regeneration by beat guard.
	Aletti East, Compartment 2 (Chonapadi).	Inspection paths; shade reduction regeneration works.
1933-34 ..	Aletti West, Compartment 3 (Devakaje).	Regirdling middle-storey; light tending.
	Aletti East, Compartment 2 (Kurlekadu).	Tending and climber-cutting.
	Aletti East, Compartment 2 (Chonapadi).	Replacement of casualties; cleaning and climber-cutting.
	Sampaje, Compartment 1 (Kuinthodu).	Artificial regeneration in blanks; tending natural regeneration.
1934–35 ..	Aletti West, Compartment 3 (Devakaje).	Climber-cutting by beat guard.
	Aletti East, Compartment 2 (Kurlekadu).	Climber-cutting; shade reduction.
	Aletti East, Compartment 2 (Chonapadi).	Cleaning and climber-cutting.
	Sampaje, Compartment 1 (Kuinthodu).	General tending; inspection by Distict Forest Officer.

Year.	Locality.	Nature of operation.
1935-36 ..	Aletti West, Compartment 3 (Devakaje).	Re-classification ; inspection by District Forest Officer.
	Aletti East, Compartment 2 (Kurlekadu).	Re-classification.
	Sampaje, Compartment 1 (Kuinthodu).	As ordered by District Forest Officer (and hereafter).
1936-37 ..	Aletti West, Compartment 3 (Devakaje).	As ordered by District Forest Officer (and hereafter).
	Aletti East, Compartment 2 (Kurlekadu).	Inspection by District Forest Officer.
	Aletti East, Compartment 2 (Chonapadi).	Re-classification ; inspection by District Forest Officer.
	Sampaje, Compartment 4 (Bantwadi), Coupe i.	Suitability map ; marking for felling.
1937-38 ..	Aletti East, Compartment 2 (Kurlekadu).	As ordered by District Forest Officer (and hereafter).
	Aletti East, Compartment 2 (Chonapadi).	Do.
	Sampaje, Compartment 4 (Bantwadi) Coupe i.	Felling and extraction.
	Sampaje, Compartment 4 (Bantwadi), Coupe ii.	Suitability map ; marking for felling.
1938-39 ..	Sampaje, Compartment 4, Coupe i.	Inspection paths ; regeneration works.
	Sampaje, Compartment 4, Coupe ii.	Felling and extraction.
	Sampaje (Baile) 7, Coupe iii ..	Suitability map ; marking for felling.
1939-40 ..	Sampaje, Compartment 4, Coupe i ..	Replacement of casualties ; weeding and tending.
	Sampaje, Compartment 4, Coupe ii.	Inspection paths ; regeneration works.
	Sampaje, Compartment 7, Coupe iii.	Felling and extraction.
	Sampaje, Compartment 7, (Baile), Coupe iv.	Suitability map ; marking for felling.
1940-41 ..	Sampaje, Compartment 4, Coupe i.	Cleaning and general tending.
	Do. 4, Coupe ii.	Replacement of casualties ; weeding and tending.
	Do. 7, Coupe iii.	Inspection paths ; regeneration works.
	Do. 7, Coupe iv.	Felling and extraction.
	Sampaje, Compartment 8 (Kanale), Coupe v.	Suitability map ; marking for felling.
1941-42 ..	Sampaje, Compartment 4, (Kanale) Coupe ii.	Cleaning and general tending.
	Do. 7, Coupe iii.	Replacement of casualties ; weeding and tending.
	Do. 7, Coupe iv.	Inspection paths ; regeneration works.
	Do. 8, Coupe v.	Felling and extraction.
	Sampaje, Compartments 7 and 8 (Kanale) Coupe vi.	Suitability map ; marking for felling.

Puttur Felling Series 'A.'

1932-33 ..	Nalkur, Compartment 1 (Katmarakettu).	Regeneration survey and re-classification.
	Do. 2, Coupe i ..	Regeneration survey ; inspection paths ; regeneration works.
	Jalsur East, Coupe ii	Regeneration survey.
1933-34 ..	Nalkur, Compartment 1	Treatment of classes i—iii ; artificial regeneration, class iv.
	Do. 2, Coupe i ..	Treatment of classes i—iv.
	Jalsur East, Coupe ii	Preparatory regeneration works.
1934-35 ..	Nalkur, Compartment 1	Treatment of class iv areas.
	Do. 2, Coupe iii	Regeneration survey ; preparatory works.
1935-36 ..	Nalkur, Compartment 2, Coupe i ..	Treatment of classes i—iv.
	Nalkur, Compartments 2 and 4, Coupe iv.	Regeneration survey ; preparatory works.
1936-37 ..	Nalkur, Compartment 1	Tending and climber-cutting ; reduction of low shade.
	Do. 2, Coupe i ..	Tending by beat guard.
	Jalsur East, Coupe ii	Marking for felling.
	Nalkur, Compartment 2, Coupe iii.	Preparatory works if necessary.
	Do. 3, Coupe v ..	Regeneration survey ; preparatory works.

Year.	Locality.	Nature of operation.
1937-38 ..	Nalkur, Compartment 1	Inspection by District Forest Officer.
	Do. 2, Coupe i ..	Reclassification; inspection by District Forest Officer.
	Jalsur East, Coupe ii	Felling and extraction.
	Nalkui, Compartment 2, Coupe iii.	Marking for felling.
	Nalkur, Compartments 2 and 4, Coupe iv.	Preparatory works if necessary.
	Nalkur, Compartment 3, Coupe vi.	Regeneration survey; preparatory woıks.
1938-39 ..	Nalkur, Compartment 1	As ordeıed by District Forest Officer (and hereafter).
	Do. 2, Coupe i ..	Reduction of low shade, etc., as oıdered by District Forest Officer (and hereafter).
	Jalsur East, Coupe ii	Regeneration woıks; inspection paths.
	Nalkur, Compartment 2, Coupe iii.	Felling and extraction.
	Nalkur, Compartments 2 and 4, Coupe iv.	Marking for felling.
	Nalkur, Compartment Coupe v. ..	Preparatory works if necessary.
	Do. 3, Coupe vii.	Regeneration survey; preparatory works.
1939-40 ..	Jalsur East, Coupe ii	Weeding and climber-cutting; replacement of casualties.
	Nalkur, Compartment 2, Coupe iii.	Regeneration works; inspection paths.
	Nalkur, Compartments 2 and 4, Coupe iv.	Felling and extraction.
	Nalkur, Compartment 3, Coupe v ..	Marking for felling; advance fellings.
	Do. 3, Coupe vi.	Preparatory works if necessary.
	Aranthakallu, Compartment 1, Coupe viii.	Regeneration survey; preparatory works.
1940-41 ..	Jalsur East, Coupe ii	Weeding and climber-cutting.
	Nalkur, Compartment 2, Coupe iii.	Treatment of classes i—iv; replacement of casualties.
	Nalkur, Compartments 2 and 4, Coupe iv.	Inspection paths; treatment of classes i—iv.
	Nalkur, Compartment 3, Coupe v ..	Felling and extraction.
	Do. 3, Coupe vi.	Marking for felling; advance fellings.
	Do. 3, Coupe vii.	Preparatory works if necessary.
	Aranthakallu, Compartments 2 and 3, Coupe ix.	Regeneration survey; preparatory works.
1941-42 ..	Jalsur East, Coupe ii ..	Tending by beat guard.
	Nalkur, Compartments 2 and 4, Coupe iv.	Weeding and climber-cutting; replacement of casualties.
	Nalkur, Compartment 3, Coupe v ..	Inspection paths; regeneration works.
	Do. 3, Coupe vi.	Felling and extraction.
	Do. 3, Coupe vii.	Marking for felling.
	Aranthakallu, Compartment 1, Coupe viii.	Preparatory works if necessary.
	Aıanthakallu, Compartment 3, Coupe x.	Regeneration survey; preparatory works.

Puttur Felling Series 'B.'

Year.	Locality.	Nature of operation.
1933-34 ..	Bantamale, Compartment 2, Coupe i.	Regeneration survey; preparatory works.
1934-35 ..	Bantamale, Compartment 2, Coupe ii.	Do.
1935-36 ..	Bantamale Compartment 2, Coupe i.	Preparatory works.
	Bantamale, Compartment 2, Coupe iii.	Regeneration survey; preparatory works.
1936-37 ..	Bantamale, Compartment 2, Coupe i.	Marking for felling.
	Bantamale, Compartment 2, Coupe ii.	Preparatory works.
	Bantamale, Compartments 1 and 2, Coupe iv.	Regeneration survey; pıeparatory works.
1937-38 ..	Bantamale, Compartment 2, Coupe i.	Felling and extraction.
	Bantamale, Compartment 2, Coupe ii.	Marking for felling.
	Bantamale, Compartment 2, Coupe iii.	Preparatory works.
	Bantamale, Compartment 1, Coupe v.	Regeneration survey; preparatory works.

Year.	Locality.	Nature of operation.
1938–39 ..	Bantamale, Compartment 2, Coupe i.	Inspection paths ; regeneration works.
	Bantamale, Compartment 2, Coupe ii.	Felling and extraction.
	Bantamale, Compartment 2, Coupe iii.	Marking for felling.
	Bantamale, Compartments 1, and 2, Coupe iv.	Preparatory works.
	Devachalla, Compartment 4, Coupe vi.	Regeneration survey ; preparatory works.
1939–40 ..	Bantamale, Compartment 2, Coupe i.	Replacement of casualties ; treatment of classes i—iv.
	Bantamale, Compartment 2, Coupe ii.	Inspection paths ; regeneration works.
	Bantamale, Compartment 2, Coupe iii.	Felling and extraction.
	Bantamale, Compartments 1, and 2, Coupe iv.	Marking for felling.
	Bantamale, Compartment 1, Coupe v.	Preparatory works.
	Bantamale, Compartment 2, Coupe vii.	Regeneration survey ; preparatory works.
1940–41 ..	Bantamale, Compartment 2, Coupe ii.	Treatment of classes i—iv.
	Bantamale, Compartment 2, Coupe iii.	Inspection paths ; regeneration works.
	Bantamale, Compartments 1, and 2, Coupe iv.	Felling and extraction.
	Bantamale, Compartment 1, Coupe v.	Marking for felling.
	Devachalla, Compartment 4, Coupe vi.	Preparatory works.
	Bantamale, Compartment 2, Coupe viii.	Regeneration survey ; preparatory works.
1941–42 ..	Bantamale, Compartment 2, Coupe i.	Cleaning and climber-cutting by beat guard.
	Bantamale, Compartment 1, Coupe iii.	Treatment of classes i—iv.
	Bantamale, Compartments 1, and 2, Coupe iv.	Inspection paths ; regeneration works.
	Bantamale, Compartment 1, Coupe v.	Felling and extraction.
	Devachalla, Compartment 4, Coupe vi.	Marking for felling.
	Bantamale, Compartment 2, Coupe vii.	Preparatory works.
	Bantamale, Compartments 2, and 3, Coupe ix.	Regeneration survey ; preparatory works.

Uppinangady Felling Series.

Year.	Locality.	Nature of operation.
1932–33 ..	Mujur, Coupe xiv	Cleaning and tending.
	Do. Coupe xv	Tending natural regeneration ; supplemental artificial regeneration ; inspection paths.
1933–34 ..	Mujur, Coupe xv	Replacement of casualties ; weeding and tending.
1934–35 ..	Mujur, Coupe xiv	Cleaning and tending.
	Do. Coupe xv	Do.
1935–36 ..	Mujur, Coupe xiv	Inspection by District Forest Officer.
	Do. Coupe xv	Do.
1936–37 ..	Mujur, Coupe xiv	As ordered by District Forest Officer (and hereafter).
	Do. Coupe xv	Do.
	Do. Coupe i	Suitability map ; marking for felling.
1937–38 ..	Mujur, Coupe i	Regeneration felling.
	Do. Coupe ii	Suitability map ; marking for felling.
1938–39 ..	Mujur, Coupe i	Inspection paths ; regeneration works.
	Do. Coupe ii	Felling and extraction.
	Do. Coupe iii	Suitability map ; marking for felling.

Year.	Locality.	Nature of operation.
1939–40 ..	Mujur, Coupe i	Weeding and tending ; replacement of casualties.
	Do. Coupe ii	Inspection paths ; regeneration works.
	Do. Coupe iii	Felling and extraction.
	Do. Coupe iv	Suitability map ; marking for felling.
1940–41 ..	Mujur, Coupe i	Weeding and tending.
	Do. Coupe ii	Weeding and tending ; replacement of casualties.
	Do. Coupe iii	Inspection paths ; regeneration works.
	Do. Coupe iv	Felling and extraction.
	Do. Coupe v	Suitability map ; marking for felling.
1941–42 ..	Mujur, Coupe i	Inspection by District Forest Officer.
	Do. Coupe ii	Weeding and tending.
	Do. Coupe iii	Weeding and tending ; replacement of casualties.
	Do. Coupe iv	Inspection paths ; regeneration works.
	Do. Coupe v	Felling and extraction.
	Do. Coupe vi	Suitability map ; marking for felling.

431. *Analysis of prescriptions applied to each felling series.*—When the working plan comes into full force (which will not be until after the year 1940-41), the areas noted in the analysis given below will need attention in each felling series in any one year according to the treatment prescribed. In computing these areas, an average size of coupe in each of the felling series has been taken.

Nature of operation.	Kasaragod Felling Series.	Puttur Felling Series. 'A'	Puttur Felling Series. 'B'	Uppinangady Felling Series.
	ACS.	ACS.	ACS.	ACS.
Felling and extraction (entire coupe)	* 66	* 190	* 93	* 80
Preparation of suitability map and marking for felling (entire coupe).	66	190	93	80
Preparatory works in evergreen areas		*48	* 23	Nil
1st year regeneration—				
Artificial measures	* 17	* 47	* 23	* 20
Total area regenerated	† 22	† 63	† 31	† 27
2nd year operations—				
Replacement of casualties	* 17	* 47	* 23	* 20
Weeding and tending	† 22	† 63	† 31	† 27
3rd year operations—				
Cleaning and general tending	† 22	† 63	† 31	† 27
Tending by beat guard	* 44	* 126	* 62	* 54
Inspection by District Forest Officer (regenerated areas).	22	63	31	27

Note.—* These are maximum areas, and will probably be less than shown ;
† These are minimum areas to be treated ;
Other figures refer to the total area of the coupe. In the case of Puttur Felling Series 'A' and 'B,' the areas of classes i and ii requiring preparatory regeneration works are arbitrarily reckoned as one-quarter of the entire coupe.

432. For the entire division, the areas requiring annual treatment are —

	ACS.	
1 Total area to be regenerated (minimum) ..	143	
2 Area to be artificially regenerated (included in (i) supra).	107	This is the maximum area permitted.
3 Area requiring preparatory works	71	This assumes only one preparatory operation ; if two operations necessary, the area must be doubled.
4 Area requiring weedings, cleanings, etc., subsequent to formation, on daily labour.	286	
5 Area which may require attention by beat guards.	286	
6 Area requiring detailed inspection by the District Forest Officer in person.	286	Includes past regenerated areas (in 5th year of formation), plus areas actually under regeneration. (This is a minimum prescribed).
7 Area requiring detailed inspection by the District Forest Officer or a gazetted assistant.	429	Includes preparation of suitability maps, and sylvicultural markings. About 43 acres will require detailed marking check.

	ACS.	
8 Area requiring supervision by the Range Officer :—		
(i) Kasaragod Range Officer ..	176	Includes coupes under felling, regeneration and subsequent tending.
(ii) Puttur Range Officer	636	
(iii) Uppinangady Range Officer ..	161	
9 Area requiring subsequent shade-reduction over young crops, and other subsidiary cultural attention.	..	This cannot be estimated in the present plan, but will not be required until after 1941-42 except in already regenerated groups prior to working plan.

The works outlined are not so heavy as those formerly undertaken in the division during the past decade, when from 1921 to 1925 an average of 500 acres of new plantation were formed annually in Kasaragod Range, and 380 acres annually in Uppinangady Range, which have since required cultural tending, in addition to coupes worked for timber.

433. The two depots of Kasaragod and Bunder Mangalore will be supplied from the following sources and to the extents shown :—

Kasaragod Market.

From Sampaje will be produced annually about 14,000 c.ft. of non-teak logs. This quantity should be absorbed without difficulty, as the Sri Lakshmi mills anticipate their requirements at 50,000 cubic feet per annum. There will be in addition the following quantities annually :—

2,500 cubic feet of teak logs from coupes i to iv of Timber Working Circle.

230 cubic feet of *Dalbergia latifolia* logs from coupes i to iv of Timber Working Circle.

600 cubic feet (approximately) of logs of all species (other than *Xylia*) from the Thodikan series of the Clear Felling Working Circle.

800 cubic feet of miscellaneous "junglewood" species are available from the Timber Working Circle if there is a market for them.

Mangalore Market.

Mujur will be the principal source of supply of logs to Mangalore. The estimated quantities of logs of species known to be saleable is 11,400 cubic feet. This quantity is a trifle less than that hitherto supplied, but the reaction in prices will be beneficial to working and may again result in our being able to extract first class logs of good deciduous species from the more remote localities of Nalkur and Bantamale. Apart from this however, the increased demand should also enable us to place other species such as *Adina Cordifolia, Albizzias, Pterocarpus Marsupium,* etc., on the market.

SECTION 9.—CONTROL.

434. The following control records will be maintained by the District Forest Officer :—

(1) The Control Book.

(2) The Regeneration Ledger.

  (*a*) For artificial regeneration under shelterwood.

  (*b*) For natural regeneration under shelterwood.

  (*c*) For regeneration of gaps.

(3) The Control Journal.

(4) The Control Maps.

Sample forms to be used are given in Appendix II.

CHAPTER III.—WORKING PLAN FOR THE PLANTATION WORKING CIRCLE.

SECTION 1—GENERAL CONSTITUTION OF THE CIRCLE AND CHARACTER OF THE VEGETATION.

435. This working circle comprises all existing plantations, whether established by clear-felling or under shelterwood, and includes also teak plantations of various sizes generally of a few acres only, which were formed from sircar kumri about thirty years ago.

436. *Plantations of deciduous species.*—The principal species in plantations established after clear-felling is teak, but other species have been introduced on a small experimental scale or have grown up naturally with the crop.

The limits of some of the older kumries in Kasaragod Range are often indefinable from the surrounding forest. There is a tendency for these to be lost sight of. The plots themselves are of mixed composition, other species having in some instances overtopped the teak. Climbers have caused a stagheaded and weakly condition of the teak in certain kumries. Other kumries require attention, but appear healthy and susceptible to improvement. The surrounding forest is probably of similar age, but details are lacking.

Various recently felled areas varying from 10 to 30 acres in extent, all of which are in Kasaragod Range, have been regenerated departmentally with teak, *Dalberigia latifolia, Pterocarpus Marsupium, Terminalia tomentosa* and a small proportion of other species.

437. In the neighbourhood of Sampaje, bamboo has recently seeded and died, and the extent to which regeneration of this species is to be looked for in future is uncertain.

438. The undergrowth in teak plantations varies with the locality and age of the plot from a scanty, thorny type accompanied by grass, to a heavy herbaceous mixed flora of transitional character tending towards evergreen in moist sheltered places. *Helicteres Isora, Glycosmis pentaphylla, Clerodendron infortunatum* and species of *Zizyphus* are common. Lantana has rarely become obnoxious. *Hybiscus furcatus* tends to gain a hold in portions of newly-felled areas, and unless dealt with early may smother all other growth in young plantations. *Mimosa pudica* rapidly invades newly-felled plantations around the edges, but is a temporary phase and can be dealt with easily. Both *Trema orientalis* and *Macaranga Roxburghii* gain rapid access to young plantations, and in certain instances have overtopped the teak.

439. *Plantations under shelterwood.*—In plantations under shelterwood *Hopea parviflora* constitutes the major part of the young crop. *Artocarpus hirsuta, Mangifera indica* and *Vateria indica* are present in small quantities. The overwood is mainly deciduous in character, but the prevailing type of ground-flora is evergreen or transitional. The evergreen middle-storey has to great measure been already removed as a sylvicultural necessity for the admittance of light to the young crop. Fellings of the overwood have also been conducted in the past decade in nearly all areas, and the residual crop contains at present few trees of exploitable size. The histories of the more important of these plantations have been summarised in Chapter V of Part I, and are to be found in Appendix IV of this plan. The appendix serves no useful purpose in the printed text, and is separately recorded in the office of the Third (Working Plans) Circle.

SECTION 2.—SUBDIVISION OF THE AREA AND ANALYSIS OF THE CROP.

440. Plantations rarely correspond with whole compartments of reserves and in some instances single compartments contain plantations formed in different years and by different methods. No permanent subdivisions have therefore been formed. The name of the reserve and the year of formation are usually sufficient to distinguish the plantations, and this system has been adopted.

441. A list of plantations, with their approximate areas, localities, and years of formation is given in the sub-joined tabular statement.

List of plantations.

Serial number and locality.	Year of formation.		Extent of the area planted in acres.	Total extent of the area planted in each reserve in acres.	Remarks.
I.—Under shelterwood—Hopea parviflora and Artocarpus hirsuta.					
Uppinangady Range.					
1 Porkala R.F. ..	1920–21 ..	Unit 1	268·5 * 216· 5 †		Hopea, *Artocarpus, Mangifera, Vateria,* 12′ × 12′
2 Do.	1921–22 ..	„ 2	50* 20†		Hopea and *Artocarpus* 27′ × 27′
3 Do.	1922–23 ..	„ 3	475		
4 Do.	1924–25 ..	„ 4	108* 50†	761·50	Hopea and *Artocarpus* 9′ × 9′ and 9½′ × 9½′
5 Padnur R.F. ..	1920–21 ..	„ 1	240· 5* 203· 7†	..	Hopea 12′ × 12′
6 Do. ..	1921–22 ..	„ 2	48· 5* 29· 5†		Do.
7 Do.	1922–23 ..	„ 3	426· 5* 408· 5†	641·50	Hopea 13½′ × 13½′
8 Mundajekap R.F.	1926–27 ..	„ 1	277	415·25	Hopea 9′ × 9′
9 Do.	1927–28 ..	„ 2	138·25		
Puttur Range.					
10 Jalsur east R.F.	1921–22 ..	Coupe I	125	252·47	Hopea 12′ × 12′ *Artocarpus* over 25 acres but casualties replaced by Hopea.
11 Do.	1922–23 ..	Coupe II	127·47		

List of plantations—cont.

Serial number and locality.	Year of formation.	Extent of the area planted in acres.	Total extent of the area planted in each reserve in acres.	Remarks.
I. Under shelterwood—Hopea parviflora and Artocarpus hirsuta—cont.				
Kasaragod Range.				
12 Parappa R.F. ..	1920–21 ..	Compartments 7 and 8, 412† ..	2207·20	Hopea 12′ × 12′.
13 Do. ..	1921–22 ..	„ 9 and 10, 331†		Do.
14 Do. ..	1922–23 ..	„ 1 and 2, 530† ..		Hopea 27′ × 27′.
15 Do. ..	1922–23 ..	„ 3, 4 and 5 (part) 474·2.†		Hopea 13½′ × 13½.
16 Do. ..	1923–24 ..	„ 5 (part) and 6, 336·5.†		Hopea 19′ × 19′.
17 Do. ..	1924–25 ..	„ 6, 72·5 † ..		Hopea 9′ × 9′.
17A Mundakole R.F. ..	1930–31 ..	„ 3, 51·0 ..		
		Total ..	4277·92	
II. By clear-felling—Teak and other deciduous species.				
Uppinangady Range.				
18 Nerankimale R.F. ..	1930–31 ..	In Fuel Coupe XVIII, 6·5 ..	6·5	Teak, rosewood and Hopea.
Kasaragod Range.				
19 Parappa R.F. ..	1928–29 ..	.. .. 16 ..	61·9	Teak, *Acrocarpus*, *Gmelina*, etc., 6′ × 6′.
20 Do. ..	1929–30 ..	.. .. 30 ..		Teak and rose wood 6′ × 6′.
21 Do. ..	1924–25 ..	.. .. 15·9 ..		Deciduous species Teak, *Terminalia crenulata Lagertrœmia*, etc., 6′ × 6′.
Puttur Range.				
22 Sampaje R.F. ..	1929–30 ..	Gunadka bit 26·5	40·5	Teak 6′ × 6′.
23 Do. ..	1929–30 ..	Bantwadi bit, 4		
24 Do. ..	1930–31 ..	Gunadka bit No. 2, 10 ..		
		Total ..	108·9	

* Area originally planted.
† Area at present maintained.

List of Teak kumries in Kasaragod Range.

Serial number.	Locality.	Name of kumri.	Area of kumri in acres.	Year of formation.	Total extent of kumri in each reserve.
(1)	(2)	(3)	(4)	(5)	(6)
I	Aletti West ..	Paimbachal	3·50	1904–09	86·28
		Nanguli, I and II	3·98		
		Kalangathamale	10·30		
		Devakaje	6·80		
		Kannadichallu	30·40		
		Pallamoola	19·80		
		Haspara	5·40		
		Adapangaya, I and II	6·10		
II	Aletti East ..	Sheikpatti, I and II	4·90	1904–09	10·00
		Chernur	2·50		
		Bettangaya	2·60		
III	Medinadka West.	Chandakanna	4·30	1915	46·63
		Haspara	11·58	1912	
		Theppa Kana	3·20	1912	
		Kudambi	1·00	1913	
		Anakallu, I and II	2·35	1914	
		Yenuvara	20·00	1914	
		Barkaje	4·20	1913	
IV	Adur	Ballakana	5·40	1909	18·68
		Ettinadi (Chinnadi)	2·00	1909	
		Mandabetta		1909	
		Katapara	5·00	1907	
		Palikochu	1·85	1913	
		Balanthadka	0·88	1904	
		Ballangunga	1·35	1907	
		Ballarkaje	2·20	1909	
V	Mandekole ..	Kallarimaly	8·50	1908	32·10
		Papathadka	1·20	1908	
		Cherukudal	16·70	1910	
		Maruthimalai	3·30	1910	
		Chakote	2·40	1911	

SECTION 3.—METHOD OF TREATMENT.

442. The object of management of the various measures prescribed for this working circle is to ensure continuity of treatment for all plantations formed prior to the commencement of this plan. Each plantation requires separate individual treatment. The operations will not differ in detail from those prescribed under similar headings in the working plan for the Timber and Clear-felling Working Circles respectively. It is considered highly probable that the majority of areas herein included will ultimately be absorbed into one or other of the above working circles, and that this will be abolished. At the present it is convenient to deal with them separately.

A.—Teak kumries and plantations formed after clear-felling.

443. Many of the teak kumries are, owing to past neglect, scarcely recognizable as plantations. They more nearly resemble the natural forest of more or less even age which has so commonly in this district resulted from similar kumri fellings before that system of cultivation was abolished. Most teak kumries are at the age (i.e., 16—26 years) when " thinnings " would normally be prescribed were the crops homogenous in their constitution and evenly spaced. This is not always the case, and the better term to use for the cultural operations proposed is " improvement fellings."

Improvement fellings.

444. Where the teak is malformed and has an uncertain future in the crop, discretion must be exercised as to the degree of opening up which is advisable. The criterion should be the ability of the remaining stems to respond to such treatment, and to re-establish close canopy.

445. A debilitated, weakly crop should be thinned out conservatively ; a vigorous crop may be thinned more drastically. Excessive opening of the canopy is however to be avoided.

446. Provided the teak is saleable, it is advisable to realize all mal-formed, stag-headed, suppressed or damaged stems in favour of trees of timber species, which possess a good growth-habit and are vigorous enough to respond rapidly and to close up the canopy at a comparatively early date. Well-grown teak poles should however be favoured by the removal of other interfering or competing species, whether saleable or no. Loranthus-infested trees should be removed ; single branches thus attacked may however be removed at discretion.

447. A final crop will probably contain about seventy trees per acre at maturity. An even distribution of trees likely to form the final crop should be aimed at.

448. An under-storey of miscellaneous trees if it exists, should be retained.

449. Creeper-cutting shall be done at the same time as the marking.

450. It is advisable that the District Forest Officer or a gazetted assistant should mark or supervise the marking of at least one-third of each area taken up annually, distributing his attention to each of the kumries in turn. Many of these are quite small, and should not involve much expenditure of time. It is important that subordinates should gain a clear understanding by example, of the nature of each operation required.

451. A five-year cycle of operations should meet the circumstances satisfactorily, and is accordingly adopted.

452. A detailed marking register need not normally be kept. The trees marked should be numbered however, and the number recorded as a check. If saleable material is felled and the plot is too small or remote to permit of adequate transport arrangements for logs, material which can be converted profitably into sleepers, kolmarams, beams, or scantlings should be sawn and carried to the nearest carting depot. In such cases proper records must be kept. If the latter alternative is also impracticable endeavour should be made to dispose of the material at site for what it will fetch.

Other sylvicultural operations.

453. Weedings, replacement of casualities, clearings, etc., in the younger plantations shall be carried out in conformity with the prescriptions laid down in Chapter IV—Working Plan for the Clear-felling (Experimental) Working Circle (paragraphs 507 to 513).

454. *Tabular statement of operations.*—

PLANTATIONS AFTER CLEAR-FELLING.

Range.	Name of block.	Compartment.	Year of formation	Year of operation.	Nature of operation.
Kasaragod ..	Parappa ..	5	1930–31 ..	1931–32 ..	Weeding and soil working ; replacement of casualities.
				1932–33 ..	* Weeding and soil-loosening ; pruning double leaders of teak ; uprootal of bamboo and *Hybiscus*.
				1933–34 ..	* Cleaning ; uprootal of bamboo and *Hybiscus*.
				1934–35 ..	Cleaning and climber-cutting ; pollarding of overtopping woody species.
				1935–36 ..	Nil.
				1936–37 ..	Inspection by District Forest Officer ; general tending as necessary.
				1937–38 to 1940–41	Works as necessary.

* Encouragement of desirable mixture from spontaneous regeneration of timber species.

PLANTATIONS AFTER CLEAR-FELLING—*cont.*

Range.	Name of block.	Compartment	Year of formation.	Year of operation.	Nature of operation.
		6	1923–24 ..	1931–32 ..	Nil.
				1932–33 ..	Cleaning and climber-cutting.
				1933–34 ..	Nil.
				1934–35 ..	Nil.
				1935–36 ..	Nil.
				1936–37 ..	Cleaning; inspection by District Forest Officer.
				1937–38 to 1940–41.	Works as necessary.
		8	1926–27 ..	1931–32 ..	Nil.
				1932–33 ..	Cleaning and climber-cutting; removal or pollarding of overtopping woody species.
				1933–34 ..	Nil.
				1934–35 ..	Nil.
				1935–36 ..	Nil.
				1936–37 ..	Inspection by District Forest Officer.
				1937–38 to 1940–41.	Works as necessary.
		9	1929–30 ..	1931–32 ..	Weeding and general tending.
				1932–33 ..	* Cleaning; uprootal of bamboo and *Hybiscus*; soil-working; pruning double leaders.
				1933–34 ..	Cleaning and climber-cutting; removal of overtopping woody species.
				1934–35 ..	Nil.
				1935–36 ..	Nil.
				1936–37 ..	Inspection by District Forest Officer.
				1937–38 to 1940–41.	General works of tending as necessary.
	Sampaje ..	1	1930–31 ..	1931–32 ..	Weeding and replacement of casualties.
				1932–33 ..	Weeding and soil loosening; pruning double leaders of teak; uprootal of bamboo and *Hybiscus*.
				1933–34 ..	Cleaning; uprootal of bamboo and *Hybiscus*.
				1934–35 ..	Cleaning and climber-cutting; pollarding of overtopping woody species.
				1935–36 ..	Nil.
				1936–37 ..	Inspection by District Forest Officer; general tending as necessary.
				1937–38 to 1940–41.	Works as necessary.
		4	1931–32 ..	1932–33 ..	Weeding and replacement of casualties.
				1933–34 ..	Weeding and soil loosening; pruning double leaders of teak; uprootal of bamboo and *Hybiscus*.
				1934–35 ..	Cleaning; uprootal of bamboo and *Hybiscus*.
				1935–36 ..	Cleaning and climber-cutting; pollarding of overtopping woody species.
				1936–37 ..	Nil.
				1937–38 ..	Inspection by District Forest Officer; general tending as necessary.
				1938–39 to 1940–41.	Works as ordered by the District Forest Officer.

TEAK KUMRIES.

Range.	Name of block.	Compartment	Year of formation.	Year of operation.	Nature of operation.
Kasargod ..	Medinadka West. (1) Anakola. bits I and II.	..	1914 ..	1932–33 ..	Thinning and climber-cutting.
				1936–37 ..	Do.
				1940–41 ..	Do.
	Aletti West— Paimbackal.	2	1904–09 ..	1932–33 ..	Improvement felling and climber-cutting.
				1936–37 ..	Do.
				1940–41 ..	Do.
	Nanguli ..	2	1904–09 ..	1932–33 ..	Improvement felling and climber-cutting.
				1936–37 ..	Do.
				1940–41 ..	Do.
	Devakaje ..	3	1904–09 ..	1932–33 ..	Improvement felling and climber-cutting.
				1936–37 ..	Do.
				1940–41 ..	Do.

* Encouragement of desirable mixture of spontaneous growth of timber species.

B.—Plantations under shelterwood.

455. *General.*—It would be well to enumerate certain important features which are characteristic of these plantations—

(*a*) With the exception of a few older broadcast-sown plots and experimental areas of a few acres each, the entire area of plantations under shelterwood was formed between the years 1920 and 1931, the great majority having been sown or planted during 1920–25. The crops are thus very nearly of the same age throughout. The considerable extent of area thus regenerated annually during these years has led to some loss of control in subsequent tending and supervision (vide paragraphs 205, 206 of Part I).

(*b*) The slow rate of growth of Hopea during early years has rendered annual tending almost essential hitherto ; and frequent attention, especially in the matter of climber-cutting is still necessary.

(*c*) Future rates of growth should be more rapid, but it is impossible to forecast accurately the various times when the overwood will require further removal. The present condition of the overwood and middle storey is widely variant from place to place.

(*d*) Site-factors governing the growth of individual plants differ not only in different blocks, but often within the same compartment. All degrees of success, from " failed areas " to " first quality areas " require therefore to be dealt with.

456. A resulting looseness in the prescriptions cannot be avoided. Detailed sylvicultural attention is essential to meet the requirements of each individual set of circumstances. The Parappa plantations are exceptionally complex. This reserve has been roughly restock-mapped by the Working Plans staff, to indicate areas where Hopea regeneration has been moderately successful, and the localities where it has failed. Failed areas are of greater extent than has been hitherto supposed or at least recorded. The difficulty of maintaining a constant acquaintance with the progressive stages of advancement of plantations under shelterwood has been remarked upon in Part I. Periodical surveys of each area are therefore essential and the responsibility for applying adequate measures devolves very largely upon the territorial staff itself. Certain areas wherein regeneration was thought to be sufficiently established were subjected in 1928—30 to heavy removals in the overwood, with the result that there is now neither regeneration nor effective canopy. It would be bad forestry to leave compartments in this depleted condition, and they are to be treated as detailed below. Minor blanks of which there are several—cannot be indicated in a map of reasonable size, and the treatment of these must come into a different category. Compartment descriptions may be referred to for more detailed notes. Occasional patches of older plants exist in many compartments in Parappa. The more important of these are shown on the map prepared with this plan, but are generally of inadequate size to warrant separate prescriptions, which would lead to confusion.

457. *Treatment of "failed areas" (partial and complete).*—Treatment will be regulated by the following considerations :—(i) The size of the area, (ii) the cause of the failure, (iii) the present condition of the soil and vegetation. These are interconnected. Definite prescriptions for invariable application are inadvisable. Treatment is suggested on the following lines :—

(*a*) If the area is inconsiderable in extent (2 acres or under), and surrounded by successful regeneration, no attempt need be made to restock the blank artificially. Such places will be restocked in course of time by natural seed-fall from surrounding Hopea trees when these commence to bear fruit. In the meantime natural regeneration of *Xylia* and other species which may happen to be present should receive requisite attention. Blanks should not be unduly exposed by further reduction of top canopy unless useful and adequate regeneration of some kind be first established.

(*b*) Larger area of two acres or more in extent will need consideration. If the initial cause of the failure was an inhospitable condition of soil and vegetation, it would be unwise to repeat the attempt within the next decade. In such areas however, Hopea plants are not entirely absent, and individuals which have become established in the partial shade of bushes or low trees are often sturdy plants which should be tended. It is important that these individuals be not overlooked. Top shade should on no account be removed from these areas except in so far as it actively interferes with the growth of Hopea.

(*c*) Extensive areas in Parappa (e.g., in compartments 8 and 9) have failed wholly or partially as the result of too drastic a removal of top canopy. Heavy weed-growth and thorny climbers have now invaded these areas. One or more of the following alternatives shall be adopted in the treatment of these areas :—(i) To clear-fell, burn and regenerate wholly failed areas with teak and other deciduous species ; (ii) to search out localities where fresh sowings of Hopea broadcast might succeed ; (iii) to locate carefully all surviving Hopea saplings in partially failed areas and ensure that these are not overwhelmed by creepers in the future.

If survivals are insufficient to form a final crop, two-year or three-year old stumps of *Artocarpus hirsuta* might with advantage be utilized to restock the area to the desired extent. If this is done, it is recommended that regular espacement be avoided in favour of direct selection of suitable places, preferably on the northern side of shade-giving trees or bushes, so that the plants have reasonable prospects of success. A combination of the above measures may be necessary.

(*d*) There are also certain areas of plantation under reasonable canopy where Hopea is thinly scattered at rather long distances apart. These are neither "failed areas" proper, nor are they successful plantations. Individual plants become difficult to locate, and are apt to be overlooked during tending. The reasons for partial failure are often obscure. If the locality is moist, no advantage is likely to be gained by waiting for spontaneous regeneration of deciduous species in the future. It is prescribed that countings be made in strips in order to ascertain whether the degree of stocking approaches to the minimum necessary to form a reasonable crop. If not, suitable areas might be chosen for broadcast sowings of Hopea in strips or patches, or attempt be made as in (*c*), to restock the area to the desired extent with stumps of *Artocarpus hirsuta*.

Tabular statement of operations.

458. *According to locality—*

A. PLANTATIONS UNDER SHELTERWOOD.

Range.	Name of block.	Compartment number.	Year of formation.	Year of operation.	Nature of operation.	Remarks.
Kasaragod ..	Parappa ..	1 and 2	1922–23 ..	1931–32 ..	Improvement fellings in overwood ; reduction of low shade.	
				1932–33 ..	Cut back damaged seedlings ; general tending.	
				1933–34 ..	Climber-cutting by beat guard.	
				1934–35 ..	Do.	
				1935–36 ..	Inspection by District Forest Officer	
		1 (i and ii) additions	..	1931–32 ..	Nil.	
				1932–33 ..	Climber-cutting in overwood ; removal of low shade over Hopea where required.	
				1933–34 ..	Nil.	
				1934–35 ..	Climber-cutting by beat guard.	
				1935–36 ..	Inspection by District Forest Officer.	
				1936–41 ..	Works as ordered by District Forest Officer.	
		3	1922 ..	1931–32 ..	Tending by beat guard.	
				1932–33 ..	Removal of low shade up to 35 feet where required; tending and climber-cutting.	Chiefly south of inspection path.
				1933–34 ..	Climber-cutting by beat guard.	
				1934–35 ..	Nil.	
				1935–36 ..	Thinning in top canopy	If not done in 1932–33.
				1936–37 ..	Inspection by District Forest Officer.	
				1937–41 ..	Works as ordered by District Forest Officer.	
		4	1922–23 ..	1931–32 ..	Nil.	
				1932–33 ..	Removal of low shade up to 35 feet where required. Tending and climber-cutting.	Broadcast sowing in blanks during good seed years
				1933–34 ..	Climber-cutting by beat guard.	
				1934–35 ..	Nil.	
				1935–36 ..	Thinning in top canopy.	
				1936–37 ..	Inspection by District Forest Officer.	
				1937–41 ..	Works as ordered by District Forest Officer.	
		5	1923–24 ..	1931–32 ..	Nil.	
				1932–33 ..	Freeing Hopea and climber-cutting * ; light shade removal south of Local Fund road.	* Especially in Teak Plot No. 7 and to north of it.
				1933–34 ..	Nil.	
				1934–35 ..	Climber-cutting by beat guard.	
				1935–36 ..	Do.	
				1936–37 ..	Inspection by District Forest Officer.	
				1937–41 ..	Works as ordered by District Forest Officer (including treatment of "failed areas").	Vide paragraph 457.
		6	1923–25 ..	1931–32 ..	Nil.	
				1932–33 ..	Nil.	
				1933–34 ..	Weeding and climber-cutting	Broadcast sowing in blanks during good seed years.
				1934–35 ..	Climber-cutting by beat guard.	
				1935–36 ..	Inspection by District Forest Officer.	
				1936–41 ..	Works as ordered by District Forest Officer (including treatment of "failed areas").	
		7	..	1931–32 ..	Nil.	
				1932–33 ..	Climber-cutting and general tending.	
				1933–34 ..	Inspection by District Forest Officer ..	Vide paragraph 457.
				1934–35 ..	Treatment of "failed areas" and blanks.	Vide paragraph 457. Thinning in old broadcast sown plot near Local Fund road.
				1935–36 ..	Treatment of "failed areas" and blanks.	
				1936–41 ..	Works as ordered by District Forest Officer.	
		8	..	1931–32 to 1940–41.	As for Compartment 7.	
		9	..	1931–32 ..	Climber-cutting by beat guard.	
				1932–33 ..	Do. Inspection of failed areas by District Forest Officer.	
				1933–34 ..	Treatment of failed areas	Vide paragraph 457.
				1934–35 ..	Do.	
				1935–36 ..	General tending, climber-cutting, etc.	
				1936–37 ..	Climber-cutting by beat guard ; inspection by District Forest Officer.	
				1937–38 ..	General tending, climber-cutting, etc.	
				1938–39 to 1940–41.	Works as ordered by District Forest Officer.	

A. PLANTATIONS UNDER SHELTEWOOD—*cont.*

Range.	Name of block.	Compartment number.	Year of formation.	Year of operation.	Nature of operation.	Remarke.
Krsaragod.. ..		10	..	1931–32 to 1940–41.	As for Compartment 9.	
	Mandekole.	3	1931–32 ..	..	Formation and replacement of casualties.	
				1932–33 ..	Weeding and replacement of casualties.	
				1933–34 ..	Tending by beat guard.	
				1934–35 ..	Weeding ; inspection by District Forest Officer.	
				1935–36 ..	Tending as ordered by District Forest Officer.	
				1936–37 ..	Inspection by District Forest Officer.	
				1937–38 and 1938–39.	As ordered by District Forest Officer.	
				1939–40 and 1940–41.	Inspection by revising officer.	
Puttur	Jalsur, East.	1 and 2 (parts).	1917, 1921–22.	1931–32 ..	Climber-cutting by beat guard.	
				1932–33 ..	Climber-cutting by beat guard.	
				1933–34 ..	Climber-cutting and freeing heads of Hopea.	
				1934–35 ..	Removal of low shade and overhanging branches.	
				1935–36 ..	Inspection by District Forest Officer.	
				1936–37 to 1940–41.	General tending as required and reduction in top canopy as ordered by Distriet Forest Officer.	
Uppinangady ..	Porkala ..	1	1920–21 ..	1931–32 ..	Nil.	
				1932–33 ..	Removal of overhanging branches ; reduction of low shade where necessary over Hopea. Pruning of double leaders ; climber-cutting and freeing heads of Hopea and *Artocarpus*.	
				1933–34 ..	Resurvey of entire area and inspection by District Forest Officer.	Sample plots to receive identical treatment. Numbered stakes to be renewed and firmly fixed in ground. Inspection by the Provincial Silviculturist is advisable(paragraph 665).
				1934–35 ..	Climber-cutting by beat guard. Treatment of "failed areas" and blanks as prescribed in paragraph 457.	
				1935–36 to 1940–41.	Climber-cutting by beat guard. Further opening of top canopy probably necessary in 1936–37 but subject to discretion of District Forest Officer.	
		1	1921–22 ..	1931–32 ..	Ni[illegible]	
				1932–33 to 1940–41.	As [illegible]21 plantation	Do.
	Porkala ..	1 and 2 parts.	1922–23 ..	1931–32 ..	Nil.	
				1932–33 to 1933–34.	Resurvey and inspection by District Forest Officer. Removal of low shade and obstructing branches ; pruning of double leaders and freeing Hopea. Treatment of "failed areas" as prescribed in paragraph 457.	Do.
				1934–35 ..	Climber-cutting if necessary.	
				1935–36 to 1940–41.	Freeing heads of Hopea and climber-cutting as necessary. Reduction of top canopy probably in 1937–38, subject to discretion of District Forest Officer.	
	Porkala ..	1	1924–25 ..	1931–32 ..	Nil.	
				1932–33 ..	Climber-cutting and tending by beat guard.	
				1933–34 ..	Removal of low shade and obstructing branches ; pruning of double leaders and freeing Hopea.	
				1934–35 ..	Resurvey of entire area and inspection by District Forest Officer.	Do.
				1935–36 ..	Climber-cutting and general tending. Treatment of "failed areas" and blanks as prescribed in paragraph 457.	
				1936–37 to 1940–41.	Climber-cutting and general tending as necessary. Reduction of top canopy probably in 1938–39, at discretion of District Forest Officer.	
	Padnur ..	1	1920–21 ..	1931–32 ..	Nil.	
				1932–33 to 1940–41.	As for Porkala 1920–21 plantation.	Do.
	Padnur ..	1	1921–22 ..	1931–32 ..	Nil.	
				1932–33 to 1940–41.	As for Porkala 1920–21 plantation.	Do.
	Padnur ..	1	1922–23 ..	1931–32 ..	Nil.	
				1932–33 ..	Climber-cutting and tending by beat guard.	
				1933–34 ..	Removal of low shade ; tending and freeing Hopea ; pruning of double leaders.	Do.
				1934–35 ..	Resurvey of entire area and inspection by District Forest Officer.	
				1935–36 ..	Climber-cutting and general tending. Treatment of "failed areas" and blanks as prescribed in paragraph 457.	
				1936–37 to 1940–41.	General tending as necessary. Reduction of top canopy probably in 1937–38 at discretion of District Forest Officer.	
	Mundaje Kap.	1 and 2	1926–27 ..	1931–32 ..	Climber-cutting by beat guard.	
				1932–33 ..	Removal of low shade up to 30 feet high where required over Hopea ; cutting back damaged stems ; weeding and climber-cutting.	
				1933–34 ..	Nil.	
				1934–35 ..	Climber-cutting and weeding.	
				1935–36 ..	Inspection of entire area by District Forest Officer and restock-mapping the area.	
				1936–37 to 1940–41.	Further reduction of canopy about 1937–38 and general tending as ordered by District Forest Officer. Treatment of "failed areas" and blanks as prescribed in paragraph 457.	

Section 4.—Other Subsidiary Operations.

459. *Quinquennial surveys.*—It is prescribed that once in five years in the order given in the tabular statement of operations, each year's plantation be in turn thoroughly examined and a full note made of the completeness or deficiencies of the stock, the state of advancement of the crop, conditions which may be impeding development, and the sylvicultural measures required in the opinion of the District Forest Officer to implement growth or to supplement deficiencies. This will be noted in the Control Journal. It is further prescribed that a sufficient number of inspection paths be kept open in order that all parts of the plantations may be conveniently inspected. At present these are inadequate.

460. *Tending.*—Prescriptions for the future removal of overhead shade, both in the top canopy and middle storeys, weeding, climber-cutting, etc., are given in paragraphs 373—376 of the working plan for the Timber Working Circle.

461. *Thinnings*—(*a*) *Broadcast-sown plots.*—In the older broadcast-sown plots the bulk of the overwood will probably have been removed already between the tenth and fifteenth years. A thinning in the Hopea crop will probably become necessary at about the twentieth year after sowing. Should any trees in the overwood still interfere with the crowns of Hopea poles, the former should be girdled. A light thinning will be made in the Hopea crop to remove badly-grown and abnormal poles in the dominant class. No sale is found at present for small Hopea poles, and therefore there is little call for the extraction of dominated and suppressed individuals, save for the danger (which might well occur) of attack upon ill-favoured stems by insect or fungoid infection. A close watch should accordingly be maintained, especially during the process of marking, for signs of insect-borers, fungoid fructifications, termite galleries, etc. All affected or suspected stems should be removed and burnt after investigation of the cause ; insects should be isolated for identification.

(*b*) *Hopea plantations.*—Thinnings in plantations of Hopea will conjecturably become necessary between the twenty-fifth and thirtieth years from the date of formation, depending on the original espacement adopted. No experience in the conduct of this operation has yet been gained and it is inadvisable to lay down rules at the present stage. The matter will come for consideration at the next revision of the plan.

(*c*) *Teak plantations.*—Thinnings will not be required during the period of the plan.

Section 5.—Control.

462. The following control records, samples of which are given in Appendix II, shall be maintained by the District Forest Officer :—

The Plantation Ledger.
The Control Book.
The Control Journal.
Samples of the first two are given in Appendix II.

CHAPTER IV.—WORKING PLAN FOR THE CLEAR-FELLING (EXPERIMENTAL) WORKING CIRCLE.

Section 1.—General Constitution of the Circle and Character of the Vegetation.

463. The vegetation at present existing on the areas chosen for this working circle is of varied nature. This has been purposely provided for in the selection of coupes in order that experience gained may not be limited entirely to one type of forest. In the series which are prescribed for departmental working, an appreciable crop of timber is to be found, the majority of which should be saleable profitably, admixed in some places with bamboo. The bamboo has very recently flowered in Thodikan reserve and seedlings are now appearing ; elsewhere the bamboo died about ten years ago and succeeding clumps are not yet mature. The prevailing type in the two departmental felling series is dry mixed deciduous, turning to moist deciduous in sheltered valleys and along stream-banks. Teak is present in the Aranthodu Felling Series near Sampaje, and also in Nerankimale, but elsewhere is almost entirely absent. Essentially *Xylia* areas have, as far as possible, been entirely excluded. The kumri felling series are covered by an extremely poor type of forest known locally as "kochi," being an inferior regrowth from former kumri clearings. The soil is generally moderately good. Lateritic soil, provided not too advanced, has been admitted during the selection of areas for felling.

Section 2.—Division of the Area.

464. The working circle is divided into the following series :—

A. *Kasaragod Range* :—
(1) The Thodikan Felling Series.
(2) The Adur Kumri Felling Series.
(3) The Aletti Kumri Felling Series.

B. *Puttur Range*—
(4) The Bantamale Felling Series.
C. *Uppinangady Range*—
(5) The Nerankimale Felling Series.
(6) The Shirady Kumri Felling Series (provisional).

SECTION 3.—ANALYSIS AND VALUATION OF THE CROP.

465. The object of this working circle being solely to experiment in the best methods of raising crops in clear-felled areas, the yields obtained from the coupes are of minor importance. No enumerations have accordingly been made for this working circle, the area of which is very small. The principal species in the crop are teak, *Terminalia tomentosa, Terminalia paniculata, Xylia xylocarpa, Dalbergia latifolia* and *Lagerstroemia lanceolata.*

SECTION 4.—METHOD OF TREATMENT.

466. *Sylvicultural system.*—The system to be employed is clear-felling with artificial regeneration of the area felled annually.

467. *Exploitation of standing crop.*—Any material which is saleable at a profit shall be removed to markets or sold in situ. The remainder will be left on the ground and burnt.

468. *Choice of species.*—Teak shall be the primary crop to be raised on all suitable localities. Other species prescribed are *Terminalia tomentosa, Pterocarpus Marsupium, Dalbergia latifolia* and *Artocarpus hirsuta.* Spontaneous growth of any good timber species is to be encouraged to form a mixture.

469. *Rotation.*—The working circle being expermental only, no rotation is at present prescribed.

470. *Regulation of the yield.*—The yield is regulated by area. In two of the series to be felled departmentally, namely, series 1 (Thodikan) and 4 (Bantamale), the coupes will average 10 to 12 acres annually. The coupes already cleared in Sampaje in 1929–30 and 1930–31 yielded about 400 cubic feet per acre. The expected yield from the Thodikan Felling Series should approximate closely to this figure. No fellings have yet been made in Bantamale reserve. An average outturn per acre for all the coupes clear-felled departmentally may safely be estimated at 300 cubic feet per acre. In the third series No. 5, the Nerankimale Felling Series, the entire coupe will average 25 acres annually of which 10 acres only come under the prescriptions of this working circle (vide paragraphs 524 and 525). The kumri felling series will be not more than 10 acres each for the first five years, but may be increased subsequently to 60 acres if there is substantial demand for such work, and provided that the work is satisfactorily done and results encourage the felling of larger areas. This is left entirely to the discretion of the management—having regard for (i) success of early operations, (ii) funds and staff available. The revenue obtained from kumried areas will be practically nil.

471. *Period for which this working circle is prescribed.*—The prescriptions are intended to cover the forthcoming ten years ending in March 1942. The necessity or otherwise for the continuance of this circle beyond that time, and the advisability of extending the scope of clear-felling operations will be considered by the revising officer. Considerable information should by that time have been collected on the cost of the several measures prescribed, upon the comparative value of different soils for teak and other species, and the possibility of estimating such values in future with reference to existing vegetation prior to felling.

SECTION 5.—EXPLOITATION.

472. *Survey and demarcation.*—Annual coupes will be demarcated by a cut line 6 feet wide and surveyed in January of the year prior to felling.

473. *Marking for felling.*—Marking and enumeration will be done in the departmental felling series only, i.e., in the Thodikan and Bantamale Felling Series, during February. The kumri felling series will not ordinarily contain merchantable material of any size, but at the time of inspection (vide paragraph 491), the District Forest Officer or a gazetted assistant will pass orders whether any marking for extraction is to be done. The method of marking will be similar to that prescribed in paragraph 336, for the Timber Working Circle, except that no girth-limits are fixed, and all trees which are convertible at a profit will be marked for extraction. There should be no duplication of numbering within the annual coupes of any single range; that is—trees will be marked serially throughout the range, not by coupes or working circles, otherwise confusion is apt to arise at depots. A 10 per cent check will be made by the District Forest Officer or his assistant.

474. *Creeper-cutting.*—A creeper-cutting will be done in the departmental felling series at the same time as the marking.

475. *Logging.*—The rules laid down in paragraph 339 will be followed during conversion.

476. *Extraction.*—All saleable material shall be extracted and dragged outside the area by the end of October at the latest.

477. *Felling unmarketable species and clearing the area.*—Useless species and undergrowth will be felled by the second week in December. The felled material should be heaped evenly over the area, and there should be sufficient material to ensure a good burn.

478. *Fire-lines.*—In January, a fire-line 12 feet wide is to be cut all round the coupe. The lines should then be scraped and burnt as early as possible in February, before burning the material in the coupe.

479. *Burning the area.*—No exact period for burning is prescribed, but the operation should be performed as early as possible. The first burn should not be later than the second week in March. It is important to secure a good and even burn in the first instance, so as to minimize costs. Large logs need not be completely burnt, and an accumulation of white-ash over a charred soil is definitely detrimental to good germination. To avoid too heavy a burn in any one locality, the felled debris should not be piled unevenly in heaps, but properly distributed over the entire area. A second burn may be necessary. This should be carried out during the last week in March. The unburnt remnants of branchwood and other material should be piled beforehand into small heaps on those portions of the ground which have been inadequately burnt. Weed-growth, and especially climbers should be destroyed as far as possible, over every portion of the coupe.

SECTION 6.—SEED COLLECTION AND NURSERY FORMATION.

480. *Selection of seed-bearers.*—Seed-bearers of all species prescribed are plentiful in the division. Recourse to seed from other districts is unnecessary save for purposes of comparison with local seed. Trees selected for seed should be vigorous middle-aged specimens, devoid of abnormalities and of good growth-habit and well-shaped crowns, situated in fertile soil, but apart from this proviso, no trees will be permanently set apart as seed-bearers, as the value of doing so is dubious.

481. *Collection of seed*—(*a*) *Teak.*—Teak seed should be collected in March or earlier if fully mature. Only large seed should be used; small seed should be discarded. The following details are provided to assist in estimating requirements :—

One bag of teak seed weighs about 60 lb. and contains approximately 48,000 seeds. A bag of seed, as picked, will yield about two-thirds of a bag of selected seed.

One acre sown at stake, 12 seeds in each patch, should require a little more than one-eighth of a bag of selected seed (or one-fifth of a bag as picked), for an espacement of 6′ × 6′; or a little more than $\frac{1}{2}$ bag of selected seed for an espacement of $4\frac{1}{2}'$ × $4\frac{1}{2}'$.

A nursery bed of dimensions 40′ × 4′ will require about one-third bag of selected seed for broadcast sowing, and should produce about 4,000 plants.

The size of the annual coupes will be usually 10 acres or multiples of 10 acres; the following estimates are based on unit areas of 10 acres :—

	Bags of selected seeds.
(i) For regenerating 10 acres by sowing at stake at espacement of 6′ × 6′ allowing for 60 per cent replacements.	6
(ii) For regenerating 10 acres as above with $4\frac{1}{2}'$ × $4\frac{1}{2}'$ espacement.	11
(iii) For regenerating 10 acres by planting stumps at 6′ × 6′ espacement.	4
(iv) For replacements of stumps in the first and second years (allowing 50 per cent replacements).	2

(*b*) *Dalbergia latifolia.*—This species does not seed equally well every year, and a sufficient number of trees must be selected to cover deficient seed-fall. The quantity required should, however, be found without difficulty. An average tree should provide $1\frac{1}{2}$ bags of pods. The seed should be ripe in March. Care should be taken to collect only the ripe fruits.

(*c*) *Pterocarpus Marsupium.*—Seed falls in March. An average tree should give about 1–$1\frac{1}{4}$ bags of seed.

482. *Nursery.*—The site of the nursery must in each case be selected by the District Forest Officer. All overhead shade will be first removed, and trees casting lateral shade should be felled or girdled all around the nursery site for a distance of 12—15 yards.

The size of the nursery should be calculated to cover the requirements of the current year's coupe, plus replacements for two years in succession in formed coupes. Allowance should also be made for stump-planting in gaps under the Timber Working Circle, where regeneration by this means is contemplated in the same range. It is preferable to select a semi-permanent site suitable for four or five annual coupes in succession. The standard size of bed now usually adopted is 40′ × 4′. For transplanting seedlings in the nursery, $2\frac{1}{2}$–3 beds will be required in addition to every bed sown broadcast, since sowing for the

following year must be done before plants are removed for stumping. For calculating the number of beds required per acre, the following ratios are suggested ; they can be regulated later by experience.

	Number of beds per acre.
(*a*) For concentrated regeneration, at 6′ × 6′ espacement :	
1. Stump-planting (standard practice)—	
Original stump-planting	0·85
First year replacements, at 33 per cent	0·28
Second do. at 20 per cent	0·17
2. Sown areas—	
First year replacements, at 50 per cent	0·45
Second do. at 20 per cent	0·18
(*b*) For concentrated regeneration, at $4\frac{1}{2}'$ × $4\frac{1}{2}'$ espacement :	
1. Stump-planting (standard practice)—	
Original stump-planting	1·25
First year replacements, at 33 per cent	0·42
Second do. at 20 per cent	0·25
2. Sown areas—	
First year replacements, at 50 per cent	0·65
Second do. at 20 per cent	0·25

During the first few years, especially in the kumri felling series, it is advisable to allow a heavy margin of safety (up to about 40 per cent) above the ratios shown. Sown areas may be filled up in the first year as casualties occur by putting out germinating seed from dumps ; if these are sufficient, the first year ratios given above may be reduced.

483. *Nursery construction.*—The construction of the nursery will be on similar lines to that required for the Timber Working Circle. If possible, the same nursery should be used for deciduous species required in both working circles. The site will be aligned, leaving a pathway 1 foot 6 inches wide around every bed. Moderate drainage should be ensured to remove suplus water during the rains. The ground selected should be dug up during March to a depth of 1 foot 6 inches. All boulders, roots and large stones should be removed and the soil broken up small. The level of the made beds should be about six inches above that of the surrounding soil. A slight initial camber is desirable in order to allow for subsequent settlement of the beds. Revetments of split bamboo should support the sides of the beds. Nursery construction should be completed by the middle of April.

484. *Sowing and transplanting.*—The nursery should be sown during the latter half of May. In years of plentiful monsoon showers no preparation of the seeds beforehand may be necessary ; but when this is not the case, teak seeds should be soaked in water for 48 hours before sowing. If germination is not entirely satisfactory, experiments in the previous weathering of seed could with advantage be undertaken. The seeds will be scattered broadcast on the beds, but not too closely, and covered by a light soil layer. The surface covering is then to be protected by a layer of straw, supported by a few thin twigs laid crosswise. The straw serves to retain moisture in the beds, and prevents the top soil-layer from being washed away. The beds will be watered on top of the straw each morning daily, by means of a watering-can with rose attachment. The straw is removed after germination.

485. *Transplanting.*—When the beds are full of seedlings having two or three pairs of leaves on them, i.e., at the end of June, or during July, the seedlings are pricked out to an espacement of about 4″ × 4″ to permit of free development. This operation should not be delayed after congestion is reached in the original beds. The work must be done carefully so as to avoid damage to the seedlings, and should be performed during rainy weather. Should a break in the rains ensue, pandals will be erected over the transplant beds to reduce transpiration, and the beds will be watered. The pandals will be again removed on cloudy or rainy days.

486. *Protection and tending in the nursery.*—The nursery will be well fenced from the start by stout stakes and split bamboo to a height of six feet. All work of preparation, sowing and tending will be as much as possible under the personal supervision of the Range Officer. A forest guard will be placed permanently in charge of nursery tending and protection, and should be held responsible for its welfare. The beds should be kept absolutely free from weeds of every description. Close attention must also be paid to the protection of the young plants from insect attack ; all grubs, insect larvæ and other pests should be hand-picked at once and destroyed, and should on no account be allowed to gain a serious hold in the nursery. The surface of the beds should be kept well loosened and not allowed

to become caked or hard. The District Forest Officer should visit the nursery as often as he is in the neighbourhood, and will see that all desirable steps are taken as they become necessary in order to hasten the production of strong healthy plants.

487. *Removal of plants from the nursery.*—Plants should be dug up progressively from one end of the bed to the other. They should never be pulled up. Particular care is necessary to avoid damage to the plants (and especially to their root-systems) during the process. Earth adhering to the roots should as much as possible be retained during transit to the planting area. The larger leaves on each plant may be removed in order to reduce transpiration. The plants should be put into baskets lined with grass and leaves, and transported as quickly as possible to the planting area without direct exposure to the sun.

488. *Travancore method.*—The above prescriptions correspond closely to what is termed the "standard method" adopted in Wynaad and Mount Stuart practice. Here, as in those districts, it will be adopted until an alternative method is found to supercede it by reason of cheapness or efficiency. It is quite possible that South Kanara conditions might favour modifications in practice which it should be the object of the management to develop, if possible. Among these, the Travancore method of nursery work for the production of stumps is suggested for trial. This is described in Chief Conservator's Proceedings No. 321, Press, dated 12th October 1928. The seeds, after soaking for 24 hours, are sown thickly, and rather later than is the usual practice. They are covered by a thin layer of soil about one-third of an inch deep. Watering is not usually required during a normal monsoon. No soil working is done, but weeds are uprooted as they occur. The resulting seedlings are long and slender. When required for stumping, in the following year they are pulled out bodily, not dug out. The actual method of stumping is described in paragraph 500. If successful, the method becomes considerably cheaper than the standard practice of transplanting, as only the one bed is required, instead of four.

489. Notching of germinating seedlings from dumps placed out in the nursery during April should also be tried. Seeds are notched out into nursery lines 4″ × 4″ apart after June 1st and as they begin to germinate. Watering of the dumps should be done sparingly on dry days if germination is backward, but the dumps are not to be disturbed. This method also eliminates the necessity for transplanting. It is, however, not advocated as an ordinary forest operation, as the danger of the plumule or radicle being damaged by careless coolies is very real.

490. After plants are removed for stumping, the beds should be immediately reformed, in order to be ready for pricking out in the following year. When a nursery is abandoned, it should be left fully stocked with teak plants at about 6′ × 6′ intervals.

SECTION 7.—INSPECTION AND PLANTING PLAN.

491. *Inspection prior to formation.*—The primary object of this working circle being to derive and record definite information and data of every kind relative to clear-felling and artificial regeneration every plantation must be regarded as an experiment. It will be necessary that the District Forest Officer places on record a proper description of each area prior to regeneration ; this is preferably done before the area is finally cleared and burnt. Soil, aspect, drainage, original vegetation, height-growth and all such relevant information should be noted in the columns provided in the Regeneration Ledger.

492. *Planting plan.*—A planting plan should be drawn up well in advance, for approval by the Conservator. This should show the espacements proposed, species to be installed, and general arrangements for regeneration. Localities considered unsuited for teak should be clearly marked on a scale plan of the annual area to be regenerated. A free hand is permitted to the management to adopt measures of the broadest possible scope, provided that objects are definitely conceived and outlined beforehand. This applies to all coupes, whatever the agency of felling and planting, and not least to kumried blocks. Experience gained as time advances should be fully taken advantage of.

SECTION 8.—FORMATION.

493. *Preparation of the area—Inspection paths.*—A six feet wide inspection path will be made through the centre of each plantation and along its greatest length. In the case of the 10-acre plantations, two paths intersecting at right-angles near the centre will be sufficient. In kumried blocks of possibly larger extent, paths will be laid out so as to divide each year's plantation into sections of not more than 10 acres in extent. These will be kept clear and drained.

494. *Aligning and staking.*—The general espacement recommended is 6′ × 6′. No definite prescription is laid down however, and it will be the object of the management to discover by experiment and adopt those espacements which appear most suitable for

conditions in South Kanara. In moist, sheltered localities, and particularly in areas where creepers are apt to become abundant, it is probable that $4\frac{1}{2}' \times 4\frac{1}{2}'$ espacement will be preferable, and this should certainly be tried. No information is yet available as to the period required before close canopy is obtained. The rate of growth of teak saplings in this division is not expected to be rapid, as compared with that in some divisions, and the "danger period" for young plantation—especially in its susceptibility to climber attack and invasion by fast-growing species—will be correspondingly longer. It is not expected that definite conclusions can be arrived at much before revision, but data should by that time have been accumulated regarding the comparative costs and advantages of different espacements, in different classes of soil and locality. The actual operations of aligning and staking the area require effective organization and supervision on the part of the ranger in charge; the method is fully described on pages 40—43 of the Madras Forest Pocket book.

495. *Pitting.*—Upon completion of staking the soil should be loosened around each stake with a pick-axe, and worked up in patches one foot square, and from 10 inches to 12 inches deep. In light soils, which are often encountered in this district, a depth of 10 inches may be sufficient, but heavier soils such as are found along nullahs and at the lower levels should be well dug to the full depth of 12 inches. Pitting on heavy soils should be done as early as possible after the area has been cleared and burnt, and the turned-up earth left to weather until just before sowing and planting.

496. *Method of formation.*—The climate of the district is not unsuited to the method of sowing at stake, which has to considerable extent been adopted in past practice with very fair regularity of germination. Seedlings are apt to suffer however, during years of drought or belated rains. Planting-out of seedlings from nurseries is also feasible on the small scale at present proposed but scarcity of labour in planting localities might very well limit the scope of this method if larger areas are adopted in the future. The same disadvantage does not weigh with so much force in the case of stump-planting, which although requiring equal organization and labour, can be spread over a rather longer period, and the stumps are able to withstand a considerable period of dry or unfavourable weather. Teak stumps also show superior growth during the first season, and have given greater certainty of success, so far as our very limited experience goes, than either of the other two methods. It is desirable that all three methods be further experimented with. The ultimate criterion must be the cost involved in obtaining a fully stocked area with established regeneration.

497. Wherever teak can be expected to grow with reasonable chances of success, this species is to be used in preference to others. At the same time it is to be remembered that the object is not to produce pure teak plantations, nor to experiment solely on the production of that species, but rather to obtain the most complete degree of stocking of valuable species possible over the area in the shortest possible time and at minimum cost. It is permissible to spend more money upon the production of a reasonably satisfactory crop of teak than upon any other species, and it is indeed extremely doubtful whether the sacrifices and expenditure involved would justify clear-felling followed by concentrated regeneration measures except when the newly-regenerated crop contains a high proportion of teak. Experience in South Kanara has already shown conclusively however, that money and effort are simply thrown away in attempting to establish a crop of teak on soil which is shallow or otherwise unsuitable. In the small 10-acre coupes prescribed in the Departmental felling series (i.e., Nos. 1 and 4), occasional negative results might be permissible if in obtaining them certain useful facts were established, but in the kumried areas, a complete restocking is to be the primary aim, whether or no the species employed is teak. If this cannot be achieved at reasonable cost, the size of the coupes must be reduced, or the series abandoned altogether. The kumried felling series are entirely provisional upon the degree of success obtained, and this fact must be made known to the kumridars beforehand.

498. The principal species other than teak which are to be used in regeneration are *Dalbergia latifolia, Pterocarpus Marsupium, Terminalia tomentosa, Artocarpus hirsuta, Albizzia Lebbek,* and *Acrocarpus fraxinifolius.* Others may be tried. Of the above, the three first-named are the most important; the others are to be tried experimentally. In and immediately surrounding teak soils, *Dalbergia latifolia* and *Pterocarpus Marsupium* are thought to be the most suitable associates. A mixture of 55 per cent teak, 25 per cent *Dalbergia latifolia,* 10 per cent *Pterocarpus Marsupium,* and 10 per cent other species will be aimed at in the final crop. *Pterocarpus Marsupium* has no very great sale in local markets, but there is danger that other species, if used in close association with teak, would outstrip the teak in the later pole stages and tend to suppress it, in all but the best teak soils.

499. The following general prescriptions should be followed until they are improved upon or modified in the light of experience.

500. (i) *Tectona grandis.*—Dibbling, and planting in prepared pits, will be the standard methods in all felling series. Dibbling of seed direct will be continued over at least one acre per annum of moderately good teak soil for the first five years, or until the management has come to definite conclusions, supported by cost-data, that other methods are ultimately the cheaper. Similarly, at least one acre will be regenerated by nursery transplants. The remainder of the area, provided it is suitable for teak, will be regenerated with stumps, this method being regarded as the most reliable.

(ii) *Sowing.*—During the first week in April, 8 to 10 selected seeds of teak will be dibbled at each prepared and staked patch. The seeds will be buried no more than about one-third inch below the surface. Dumps of seeds will be put out at the same time about 70 yards apart over the sown area (i.e., about one dump per acre). These are left uncovered and are intended to provide seedlings for replacement of casualties as they occur.

(iii) *Planting of nursery seedlings.*—These will be put out directly the monsoon actually bursts. A wet day should be chosen for the operation. The plants should be preferably one month to six weeks old. They should have been dug up and transported to the site over-night in baskets, tied in convenient bundles of 25–50. Labour must be properly organized and told off ready on the spot in the morning. The organization required for such very small areas as are at present proposed is negligible, but if the method on a larger scale becomes favoured in this district as in Nilambur, it becomes of the first importance, the more so as labour at this season is difficult to attract. Planting rules, which require no elaboration here, are clearly set forth in the Madras Forest Pocket Book.

(iv) *Stump-planting.*—This method is almost new to the division, and many subordinates have no experience hitherto in the correct procedure. For stumping, plants sown in the nursery during May or June of the previous year are used. In the "standard method," these are pricked out as described already in paragraph 485, and should be stout thrifty plants with well-developed stems by the time they are required. Cuttings of the root and shoot will be done immediately after removal from the nursery. The cuts should be made with a sharp knife so as to leave a clean slanting surface. There should remain from 1 inch to 2 inches of stem above the collum, and about 9 inches of tap-root. Side roots should be pruned off close to the main root. Forked or malformed rootstocks should be rejected, and the stumps put out in the planting area with the maximum of despatch, without allowing direct exposure to the sun.

Planting should be completed by the middle of May. The area must have been previously prepared as described in paragraphs 494–495. The principal points to be watched during planting of the stumps are the following :—

(*a*) The hole in which the plant is inserted is made by means of a crowbar or a hard pointed stake, in the middle of the prepared patch to the exact depth corresponding to the length of each individual root measured below the collum ;

(*b*) the stump is planted with the collum exactly at surface level ;

(*c*) the earth around each stump must be well tamped into place leaving no air spaces around the root, so that the stump after planting is capable of withstanding a fairly hard tug without being withdrawn.

The same precautions must be observed when planting by the Travancore Method, especially in closing the hole, which is done by making a second slanting thrust with the crowbar close to the first hole and exerting sideways pressure against it. This method can also be tried in kumried areas without previous preparation of the soil, provided that soil is not too heavy.

501. *Dalbergia latifolia.*—This species succeeds easily in Kanara from seed dibbled at stake. Stumps cut from one year old plants in the nursery should also be tried for the purpose of comparison in rate of growth, etc. The practice hitherto adopted of using this species along with *Pterocarpus Marsupium* in the three outer rows of the plantation may be continued. The advantage of this species as an under-storey and associate with teak has been recognized. In many clear-felled coupes it has been observed to occur spontaneously with some profusion both from seed and root-sucker, the latter often very vigorously. It is not known definitely to what degree root-suckers survive in subsequent years, and it is desirable that this should be ascertained by staking and counting all natural first year seedlings and root-suckers over, say, $\frac{1}{4}$ acre, and re-counting in subsequent years. At Mount Stuart dibbling of this species along with teak at every stake is being undertaken. Where the teak fails but the *Dalbergia* plant survives, no replacement of the former is made, and the latter takes its place in the plantation. While not prescribed as an invariable rule for South Kanara, especially since a large number of natural seedlings often occur in plantations, the method is to be tried experimentally, to observe whether there is any ultimate savings to be derived in the reduction of subsequnet replacements. Two rows will be sown with *Dalbergia latifolia* alongside the teak, followed by one row of *Pterocarpus Marsupium* and so on throughout the area. Three or four dried and broken pods of the

former should be sown at each stake at the break of the rains. After the first year or two *Dalbergia latifolia* can survive against considerable competition from surrounding vegetation. Pure crops of this species have been raised very successfully from kumries at Sampaje in Coorg. Similar pure plantations from kumri may be attempted, but it is desirable that more cautious experiment be made first, both from seed and stumps, in these series.

502. *Pterocarpus Marsupium*.—This species rarely grows to large size in Kanara and is a useful associate with teak. The seed should be soaked for 48 hours in cowdung and water before sowing. It is suitable in partial shade along the periphery of coupes, and will also be tried experimentally in staked patches along with the teak, as described above.

503. *Terminalia tomentosa*.—Low-lying heavy soils are suitable for the introduction of this species. It is, however, readily adaptable to other classes of soil. Its rate of growth in Kanara is apt to outclass that of teak during the pole stage, and it is therefore not recommended as a close associate, but in groups where teak does not do well. Direct broadcast sowings have had success, and the method may be repeated on small non-teak patches. If sown at stake 8 to 10 seeds should be placed in each patch. Sowing should be done at the commencement of the rains. A small reserve of nursery seedlings sown in April-May should be retained for planting out during replacement of casualties.

504. *Xylia xylocarpa*.—Artificial sowing and planting of this species is not prescribed. In localities suited to *Xylia*, seedlings and root-suckers will appear spontaneously and these may be encouraged during the course of tending to form a mixture with other species or to fill up blanks.

505. *Artocarpus hirsuta*.—This species is prescribed on a small experimental scale in clear-felled plots. Judgement must be exercised in the selection of suitable sites for its introduction. The edges of streams and nullahs, low-lying moist localities, and the edges of coupes bearing partial shade from surrounding vegetation are those thought most suitable ; exposed southerly slopes should be avoided. Stumps cut from 2-year and 3-year seedlings should be tried, also nursery transplants 1–2 months old. The raising of plants from seed sown direct in bamboo tubes, although once an entire failure at Parappa, should be again attempted in more suitable localities. Seeds ordinarily lose their vitality after a week, and should be sown not more than three days after collection. The plants require shade while in the nursery.

506. *Albizzia Lebbek and Albizzia odoratissima*.—These species should be easily raised from direct sowings, and may be used in light soils unsuited for teak.

Section 9.—Subsidiary Sylvicultural Operations.

507. *Weeding*.—Herbaceous weeds and climbers take rapid hold of exposed ground from the commencement of the monsoon showers in May, and during the ensuing six or seven months all plant metabolism is extremely active. The importance of securing full stocking and the maximum height-growth of teak plantations during the first season needs no emphasis here. Weeds are the most serious menace to clear-felled plantations in Kanara, and first season attainments will be less than satisfactory if weed-growth be allowed at any time to get out of hand.

508. *First-year weeding*.—In newly burnt and regenerated areas, weeds usually become obnoxious about the end of July. All young plantations must therefore be weeded not later than the second week of August. Weeding shall be done in lines ; in the case of a 6′ × 6′ espacement the lines will be four feet wide, i.e., two feet on either side of the planting rows, and in the case of a $4\frac{1}{2}' \times 4\frac{1}{2}'$ espacement, the strips will be made three feet wide. As in other operations in this working circle, no single method of weeding is rigidly prescribed to the exclusion of others. Results recently obtained in other divisions, and by the Provincial Sylviculturist (vide the Annual Report for 1930–31 on sylvicultural research in the Madras Presidency) favour mamooty-scraping and forking rather than cutting back of weeds or hand-pulling. Both mamooty-scraping, and a forking by means of forked mamooties, are to be tried therefore. At the first weeding, lines or strips will be made in one direction along the planting rows, and at the second weeding, the lines will be at right-angles to the original direction. The uprooted weeds should be piled on the intervening unweeded strips. On no account should the removal of weeds alongside seedlings leave holes which will become waterlogged. Natural growth of woody species should not be cut or uprooted except where they actively interfere with the growth of teak seedlings, or by the order of the District Forest Officer. The second weeding will be timed to suit the circumstances in September or the first half of October. A third weeding may be necessary in December ; this should include a hand-uprootal or cutting-back of bamboo and other obnoxious regrowth.

509. *Second-year weeding*.—Operations will be similar to those described above.

510. *Soil aeration.*—Light soils will require little attention in this respect, but in heavy clayey soils alongside nullahs a forking should be made to a depth of about four inches and for a radius of two feet around each plant at the beginning of the first showers in May. Where forking as described in paragraph 508 has been already done in two directions, no further soil aeration should be necessary.

511. *Mulching* may be given where it is considered necessary. Its advisability is left to the management to decide from experience.

512. *Replacement of casualties.*—Casualties will be replaced during the first season as they occur. In sown areas, surplus seedlings at other stakes will be transplanted, or germinating seedlings taken from dumps. Planted areas will be supplied by stumps or seedlings transplanted from the nursery. At the final weeding, surplus plants in sown patches will be pulled up, leaving only the sturdiest and most forward at each stake. Where a *Dalbergia* or a *Pterocarpus* seedling is present alongside a teak seedling, one plant of these species should also be retained. Second-year casualties will be replaced by stumps early during the rains. It will not be necessary to replace a teak seedling if a *Dalbergia latifolia* or a *Pterocarpus Marsupium* seedling survives at the same stake.

513. *Cleanings.*—Cleanings are necessary from the third year onwards until the plantation is out of danger from competing growth. All climbers, bamboos and competing herbaceous species shall be cut back, and the heads of young plants kept free. *Macaranga, Trema, Mallotus, Grewia* and similar fast-growing woody species are to be cut ; pollarding of these species at about breast-height is to be tried, as height-growth may effectively be prevented by this treatment, while some degree of protection is afforded to the soil. Useful timber species from seed or root-sucker are to be retained as a supplementary crop and to provide a mixture, provided that promising teak plants are not prejudiced. Should blanks occur after the second season, coppice-shoots of useful species should be encouraged to fill the blanks wherever possible.

514. *Tending.*—Double leaders and persistent side-branches will be pruned from the second year, unless the cost of doing so, in addition to the other necessary works, prove prohibitive.

515. *Drainage.*—In order to prevent undesirable wash on steep slopes, small catchment drains about six inches deep should be provided along contours, leading off gradually into natural water-courses. These need be provided only during the first season as a rule.

SECTION 10.—THE KUMRI FELLING SERIES (SERIES 2, 3 AND 6).

516. No definite coupes have been laid out ; the management may select which coupes are most convenient in the areas marked on the management map. Areas suitable for teak will be personally selected by the District Forest Officer. Areas unsuited for teak will be planted or sown with other deciduous species, of which the most important are *Dalbergia latifolia* and *Terminalia tomentosa.*

517. The times for felling, clearing, burning and sowing (or planting) will be the same as already described for departmental working. All work of nursery preparation, stumping, planting, etc., will be done by the kumridars under direct departmental supervision, and paid for in the ordinary way. In teak areas only teak stumps will be employed.

518. While cereal crops are on the ground, i.e., from May onwards until October, the timber crop shall be kept weeded by the kumridars at the same time as they attend to their own crops. Patch weeding around each seedling shall be done to a diameter of one foot. Particular attention should be paid during the latter end of the season to ensure that the cereal crop does not fall over and obscure the timber crop. Casualties will be replaced during this period by the kumridars.

519. After harvesting, which is done usually in October, the Department will take over entire charge of the area, and do all the tending necessary. The kumridars shall however, clean-weed it in strips as previously described, before leaving. A final weeding, if necessary, will be done by the Department in December. At the time the area is taken over by the Department there should be 100 per cent stocking on the area.

520. Only one cereal crop will be raised on the same area. Should the operations prove successful in Kasaragod Range, and provided that the staff are able to cope with other areas, such may be opened at the discretion of the management at any time. A Shirady Kumri Felling Series is provisionally prescribed, for which a suggested location is the southern bank of Gundia river, in Konaji reserve, where the present crop is poor.

521. No rewards to kumridars shall be given.

Section 11.—The Nerankimale Felling Series.

522. The object of this series is to improve, if possible, the value of the crop in Nerankimale reserve by methods similar to those employed in other clear-felled areas in this working circle.

523. The coupes chosen for the next ten years will be worked in conjunction with the prescriptions given in paragraphs 538 and 539 of the Fuel Working Circle. The average size of the coupes felled is 22 acres, equal approximately to the size of previous coupes in this reserve.

524. The felling and removal of produce from the coupes is to be continued, as hitherto, on contract. The sale of the coupes will be conducted annually by auction; if there is no demand, or if the District Forest Officer does not confirm the sale, it is desirable that not less than 10 acres be felled and regenerated annually by the Department. Final decision on this matter is however left to the District Forest Officer in consultation with the Conservator.

525. In the event of the coupe being sold, the following procedure should be adopted :—

(i) The coupe must be handed back to the Department by the contractor not later than the 1st April. No extension of voidah can be allowed.

(ii) Not less than 10 acres in each coupe will be burnt and regenerated artificially and subsequently tended according to the prescriptions given for this working circle. The localities containing soil most fit for teak will be chosen by the District Forest Officer. These should be if possible in one single patch, but this is not insisted upon. They may, if necessary, be scattered in patches of 1–2 acres in extent.

(iii) The remaining areas will be regenerated by the method of simple coppice upon the lines laid down in detail in the Working Plan for the Fuel Working Circle (vide paragraphs 538 and 539).

(iv) It is essential that all parts of the coupe, whether regenerated by concentrated sowings and planting at regular intervals, or by coppice, should be restocked throughout at the end of the first season.

526. The revising officer should be able to determine at the end of the period which method of treatment gives the better results in view of (*a*) the quality of the resulting crops, and (*b*) the respective costs of formation and maintenance, and accordingly whether this reserve should be retained for fuel or transferred to the Timber Working Circle.

Section 12.—Tabular Statement of Operations.

527. The following table of operations is common for all series :—

Year.	Coupe number.	Felling and clearing the area.	Regeneration.	Replacement of casualties.	Weeding.
1932–33	I	I	..	..	..
1933–34	II	II	I	I	I
1934–35	III	III	II	I II	I II
1935–36	IV	IV	III	II III	I II III
1936–37	V	V	IV	III IV	II III IV
1937–38	VI	VI	V	IV V	III IV V
1938–39	VII	VII	VI	V VI	IV V VI
1939–40	VIII	VIII	VII	VI VII	V VI VII
1940–41	IX	IX	VIII	VII VIII	VI VII VIII
1941–42	X	X	IX	VIII IX	VII VIII IX

Section 13.—Control.

528. The following records will be kept by the District Forest Officer :—

The Control Book,
The Regeneration Ledger,
The Nursery Ledger,
The Control Map.

For the present no Control Journal is necessary ; all information normally entered in the Journal will go into the special form prescribed in the Regeneration Ledger for each coupe, the object being that specific data consistent with the experimental nature of the work should be collected for subsequent comparison of one coupe with another.

CHAPTER V.—WORKING PLAN FOR THE FUEL WORKING CIRCLE.

SECTION 1.—GENERAL CONSTITUTION OF THE WORKING CIRCLE AND CHARACTER OF THE VEGETATION.

529. (*a*) *Character of the vegetation.*—Blocks classified as " fuel reserves " fall naturally into two groups, viz., coastal reserves and those which are situated inland at a distance of 30 miles or more from the coast. Their respective characters differ considerably. The former group, comprising such reserves as Muliar, Karadka and Kalanjimale, as well as others not included in this working circle at present, have soils scanty in leaf humus, and markedly lateritic for the most part, the vegetation on which varies from grassy scrub to a deciduous forest of small dimensions. Growth is slow ; the northern parts of Muliar reserve, which consist of a shallow laterite soil, have not been worked during the past twenty years yet show slow progress and are not at present suitable for felling. Similar conditions obtain in Virakhamba reserve, formerly overworked, and not included in this working circle. Coupes which adjoin the Paiswani river in Muliar and Karadka reserves, contain on the other hand a satisfactory crop which coppices well. *Lantana aculeata* has taken a vigorous but not overwhelming hold in the felled coupes of Muliar, in spite of measures for its eradication undertaken hitherto in conformity with prescriptions in the old working plan. In the few unworked coupes which now remain this species has been practically eliminated in the interior and is found almost only around the edges of the coupes.

530. The more inland fuel reserves of Nerankimale and Narimogar, as also Kunthur, possess superior growth containing small timber. Nerankimale reserve is one of the few blocks containing teak. *Terminalia tomentosa* and *Terminalia paniculata* are predominant species, but *Xylia xylocarpa* is often almost a pure crop on the crests of hills. Immature clumps of *Bambusa* occupy blanks. Coppice regeneration is generally very vigorous. The vigour with which stumps throw out coppice shoots is largely contingent upon soil conditions. In good soils, coppice shoots of teak and *Terminalias* are generally successful in outstripping competing weed-growth, but elsewhere climbers, especially *Hybiscus furcatus*, imperil regeneration by forming a heavy thicket extremely difficult to penetrate. In these circumstances, which are prevalent in Nerankimale reserve, the old system of " Coppice with standards " if properly applied, would appear to possess certain advantages in reducing the vigour of weed-growth and in assisting reproduction from seed which under the present system of " Simple coppice " is severely prejudiced. On the other hand, the present system has given eminently successful results in *Xylia* areas, e.g., in Narimogar reserve, where a pure thicket of coppice and root suckers has resulted in many places.

531. A noticeable feature in almost all protected moist localities, even in coastal reserves, is the rapidity with which the older coupes have acquired a ground-flora of evergreen shrubs. Coupes only 12 to 15 years old on the northern and eastern flanks of Kalanjimale reserve, for instance, display a dense lower flora of *Webera, Psychotria* and *Aporosa*. This is interesting in that it demonstrates the shortness of the period necessary in certain circumstances to produce these conditions, although it is reasonable to suppose that they pre-existed before the coupe was felled, and were only temporarily disturbed thereby.

532. Subsidiary species common in all coupes are *Strychnos Nux-vomica, Aporosa Lindleyana, Bridelia retusa, Anacardium occidentale, Phyllanthus, emblica.* Some *Bambusa* is generally present, and *Santalum album* is found sporadically. *Hopea Wightiana*—a valuable fuel-wood—is found in moist situations, especially near river banks. In suitable conditions, such as may readily be observed near the Uppinangady Local-fund Rest-house, the last-named species readily regenerates itself in the open.

533. (*b*) *Constitution of the working circle.*—The fuel series prescribed for the period of this plan are as follows :—

	Area.	
Kasargod Range—		
Muliar-Karadka Felling Series	2,476	acres.
Puttur Range—		
Narimogar Felling Series	880	„
Uppinangady Range—		
Nerankimale Felling Series	980	„

The sale of fuel coupes in the recent past has not met with much encouragement. Owing to absence of demand, Kalanjimale series in Puttur Range and Kunthur series in Uppinangady Range are temporarily closed. The Kalanjimale series is well situated with respect to Panemangalur and the coastal towns. This series may accordingly be reopened by the management directly there are indications of revived interest by competitive bidding at auction sales, or if there is a definite demand for these coupes. A trial sale should be advertised by the District Forest Officer whenever he considers the time opportune.

534. A working plan for Kunthur series already exists, but has never been put into operation owing to the long lead to markets. It is considered unlikely that there will be a demand for this series at all during the period of this plan ; if it arises the existing plan may be put into operation as regards lay-out of coupes, but the prescriptions of sections 5, 7, 8 and 9 of this chapter will cancel all previous instructions regarding method of treatment.

535. In general for the whole working circle, it is prescribed that should demand at auction sales continue fitful and lacking in desirable competition for coupes advertised, as at present appears to be the case, the management may at any time with the authority of the Conservator, close down one or more series ; and this course is advised rather than to endeavour unsuccessfully each year to sell coupes for which no more than one contractor is forthcoming to bid in each instance. Produce from unreserve kumakies, private wargas and casuarina topes along the coast will probably continue to satisfy a large measure of local requirements for some years, except in the neighbourhood of large inland towns such as Puttur and Uppinangady. The depletion of private resources is perhaps not far removed in parts of Kasargod Range, a circumstance which will be revealed in an increased interest in Government sales hereafter. The District Forest Officer would do well to keep in touch with the fuel supplies to the Mangalore tile industry in which it is believed a shortage is threatened, and it may not be difficult to persuade some firms to negotiate direct with the Department for their future supplies, one difficulty hitherto being that they do not desire responsibility for the actual contract of felling and removal from coupes.

536. *The Muliar-Karadka series.*—In the Muliar-Karadka Felling Series, only one coupe remains to be worked in Muliar reserve, viz., coupe XX of the present series. If substantial demand is felt, an area located in Karadka reserve has been selected for working during the next ten years, and further coupes can be added on to this area at revision of the Plan, to complete the desired rotation of forty years (vide paragraph 545 below).

537. *The Narimogar series.*—This series, hitherto in Uppinangady Range, is transferred in the present plan to Puttur Range.

538. *The Nerankimale series* has been worked for fuel and small timber over a total area of 506 acres. Ten further coupes have been selected for the next decade, which total 243 acres in extent. In the block south of Upparhalla stream there still remains in addition to the above, an area of about 1,065 acres. Of this, an area of 230 acres lying to the east of the proposed coupes for the forth-coming period has been indicated on the 4-inch scale map as probably suitable for extension of the coupes to complete the desired 40 years rotation, but no coupes have been laid out. The remainder of the reserve has not been stock-mapped, but it may for the present be conveniently included in the Protection Working Circle. There is a strip of land to the west of the reserve boundary separating coupes vii, viii and x (new series) from the Netravati Hole. The District Forest Officer should consider the desirability of acquiring this.

539. Those coupes prescribed for the next decade are required to be regenerated partially in accordance with prescriptions embodied in the Clear-felling (experimental) Working Circle—vide paragraph 523. It is desirable therefore that as few interruptions as possible be permitted in the felling of these coupes. This in no way implies the necessity for selling them at prices below their real market value. If necessary, the management should arrange for the departmental felling and disposal of the produce from areas ear-marked for experimental regeneration by departmental agency, as will be done in other series prescribed for the Clear-felling Working Circle. If such a course appears unavoidable, it might be advisable to operate first in the three coupes nearest to the river (Nos. vii, viii and x) which contain probably the best teak soil as well as better material for extraction, the same being transported to the coast by river direct. This will obviate the necessity for disturbance of the remaining coupes, which may be worked later in the ordinary way.

540. It is emphasized that there is no real need to continue the felling series for the purpose of fuel supply if public demand is lacking. There is reason to believe that the coupes within recent years have been felled by contractors principally on account of the timber contained therein—of which a proportion was teak—and for fuel only as a secondary consideration. If the experiments in artificial regeneration in these coupes provide sufficient promise that teak and other first-class timber species can be raised at a reasonable

cost, the revising officer should in due course consider the re-allotmnet of areas so that portions suitable for the production of timber in high forest will be apportioned to other working circles, and no longer treated as fuel forest.

SECTION 2.—DIVISION OF THE AREA.

541. No compartments have been formed in any of the reserves constituting this Working Circle. The coupes, indicated by serial numbers in rotation as worked, are the sole subdivisions necessary. The felling series are known by the local name of the reserve or block in which they are located.

SECTION 3.—ANALYSIS AND VALUATION OF THE CROP.

542. No enumerations or evaluation surveys have been made.

SECTION 4.—METHOD OF TREATMENT.

543. *The sylvicultural system* prescribed for all coupes, with the exception of selected portions of Nerankimale series, is "simple coppice." A portion of the Nerankimale series will be regenerated according to prescriptions embodied in the Clear-felling (experimental) Working Circle (vide paragraph 522). Portions not so treated will be regenerated according to the prescriptions of this Working Circle.

544. *Rotation.*—The object of management is to secure the production of billet fuel-wood of dimensions which fetch a maximum price in Bombay and local markets. This size is between 15 inches and 24 inches girth. Measurements recorded in Narimogar reserve, a good average type of fuel crop but superior to the coastal fuel reserves, indicate that the mean annual girth increment, taking all common species into consideration, is in the neighbourhood of 0·65 inch per annum at 4′ 0″ above ground level. An abstract of these figures is shown in Chapter VI of Part I. They unfortunately relate only to coupes up to sixteen years of age. In North Mangalore Division a large number of measurements taken in ten different reserves of various qualities and ages of stock show a mean annual girth increment of 0·56 inch at breast-height. A figure of 0·6 inch may therefore be taken for the purposes of calculation. Suitable girth dimensions would therefore be reached in a rotation of 40 years which is accordingly adopted. If the rate of growth happens in certain instances to be superior to the above hypothetical figure, this is no disadvantage, since small timber is in considerable local demand for building purposes, posts, agricultural implements, etc. Where third-class quality teak can be established, the above is an economic one. It also permits of adequate soil protection and improvement.

545. *Yield.*—The yield is regulated by area. Coupes of approximately equal areas have been indicated on the management maps for all series. The working plan staff have not separately assessed the volume outturn of each individual coupe.

546. The areas indicated in the working plan maps for the decennial period 1931–40 are as follows :—

	ACS.
Muliar Karadka Felling Series—	
Muliar, coupe XIX (old series), Karadka, coupes I to IX (new series)	563
Narimogar Felling Series—	
Coupes I to X (new series)	218
Nerankimale Felling Series—	
Coupes I to X (new series)	243

547. The average yields obtained from the several series in the past are tabulated in Chapter V of Part I. On this basis the average yields to be expected are respectively as follows :—

Felling series.	Average area of coupe (acres).	Past average yield per acre under "Simple coppice."		Forecast of average outturn per annum.	
		(a) Fuel in chowks.*	(b) Timber in cubic feet.	(a) Fuel in chowks.	(b) Timber in cubic feet.
(1)	(2)	(3)	(4)	(5)	(6)
Muliar-Karadka	56	4	26	224	1,456
Narimogar	22	12	47	264	1,034
Nerankimale	24	11	177	264	4,248

* *Note.*—One "chowk" equals 216 cubic feet of billetted and stacked fuel-wood, or approximately three tons.

SECTION 5.—METHOD OF EXECUTING THE FELLINGS.

548. With the proviso mentioned in paragraph 535, one coupe in each felling series will be advertised and sold in public auction annually in the month of March to a contractor who will conduct the fellings and removal of produce from the coupe in accordance with the terms of agreement now in force in the district.

549. All dead trees and bamboo clumbs will be felled. Sandal trees will be left standing. Adequate host plants (and, in the case of seedlings or saplings, side shelter) will be left to ensure their survival.

550. The following procedure will be adhered to :—

(*a*) The coupe will be divided into convenient-sized strips, generally two.

(*b*) The contractor will proceed with each strip serially, commencing at one end and felling uniformly to the other end. The contractor should not be allowed to proceed to the next strip until the completed one has been inspected and passed by the Range Officer, who should certify that the work has been satisfactorily performed.

(*c*) All growth shall be cut as close to ground-level as is practicable. Stumps of undesirable species are to be hacked so as to prevent coppice.

(*d*) The contractor for the year will be responsible for the construction and maintenance of extraction roads at his own expense, which work will be done in accordance with instructions issued by the Range Officer.

Section 6.—Tabular Statement of Fellings and Subsidiary Operations.

551.—

Year.	Felling and coppicing.		Regeneration in blanks and patches.		Cleaning and climber cutting.		Tending and climber cutting.	
	Coupe number.	Area in acres.	Coupe number.	Area in acres.	Coupe number.	Area in acres.	Coupe number.	Area in acres.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
			Mudiar-Karadka Felling Series.					
1931–32	XIX	53	..	..	..	..	..	..
1932–33	I	64	XIX	53	XIX	53	..	..
1933–34	II	64	I	64	I	64	..	..
1934–35	III	62	II	64	II	64	..	..
1935–36	IV	62	III	62	III	62	..	..
1936–37	V	61	IV	62	IV	62	XIX	53
1937–38	VI	61	V	61	V	61	I	64
1938–39	VII	64	VI	61	VI	61	II	64
1939–40	VIII	66	VII	64	VII	64	III	62
1940–41	IX	63	VIII	66	VIII	66	IV	62
1941–42	X	60	IX	63	IX	63	V	61
			Narimogar Felling Series.					
1932–33	I	21	..	..	..	..	..	..
1933–34	II	19	I	21	I	21	..	..
1934–35	III	23	II	19	II	19	I	21
1935–36	IV	23	III	23	III	23	II	91
1936–37	V	20	IV	23	IV	23	III	23
1937–38	VI	20	V	20	V	20	IV I	23 21
1938–39	VII	22	VI	20	VI	20	V II	20 19
1939–40	VIII	23	VII	22	VII	22	VI III	20 23
1940–41	IX	23	VIII	23	VIII	23	VII IV	22 23
1941–42	X	24	IX	24	IX	24	VIII V	23 20
			Nerinkemale Felling Series.					
1932–33	I	26	..	..	..	..	..	..
1933–34	II	20	I	26	I	26	..	..
1934–35	III	33	II	20	II	20	I	26
1935–36	IV	20	III	33	III	33	II	20
1936–37	V	20	IV	20	IV	20	III	33
1937–38	VI	20	V	20	V	20	IV I	20 26
1938–39	VII	22	VI	20	VI	20	V II	20 20
1939–40	VIII	20	VII	22	VII	22	VI III	20 33
1940–41	IX	21	VIII	20	VIII	20	VII IV	22 20
1941–42	X	23	IX	21	IX	21	VIII V	20 20

Section 7.—Subsidiary Sylvicultural Regulations.

552. *Regeneration.*—Coppice regeneration, supplemented by natural reproduction from seed and root-sucker, will be relied upon to restock the greater part of the area.

553. Unstocked blanks are, however, to be looked for, and should, so far as it is reasonable and economical, be restocked by artificial measures. Small blank areas are certainly uneconomical to deal with; they are usually lost sight of in ensuing years, and become overgrown with weeds in a short time. Artificial measures are therefore best restricted to very incompletely stocked areas, of not less than half an acre each in extent. These will be treated intensely. The Range Officer must first inspect a coupe closely before it is felled. He should plot on a large scale sketch of the coupe what areas are likely to require artificial regeneration. The conclusions arrived at shall be reviewed by the District Forest Officer, during the course of felling, or after felling is complete, by personal inspection, and final orders will then be passed. The exact course of procedure is left to the circumstance of each case. The blank areas unless naturally evergreen, must be burnt as well as possible. If there is insufficient material on the ground to provide a uniform burn over the whole area, such as there is should be collected in lines (or, if inadequate for this, in heaps) and burnt in the month of April. If the ground is suitable, teak stumps will be introduced; in other places seeds of good deciduous species such as *Terminalia Tomentosa*, *Terminalia paniculata*, *Xylia xylocarpa*, *Dalbergia latifolia*, and *Pterocarpus Marsupium* will be sown in prepared patches on the burnt areas. In moist localities, stumps of *Artocarpus hirsuta* will be planted. Exact alignment and espacement is not called for, but the stumps or seedlings should be staked. In areas which cannot be effectively burnt, broadcast sowing of seeds of *Terminalia tomentosa* and other species, a method which has given good results in the past, should be tried. Teak stumps will be planted out in the second or third week of May. *Artocarpus* stumps will be planted during the early monsoon showers. Sowing of seeds of deciduous species should be done at the end of May. In moist localities, where evergreen vegetation is found, the growth need be merely cut, but not burnt. A broadcast sowing of *Hopea Wightiana* should be made in such localities, directly following the preliminary monsoon showers. In soils markedly lateritic supporting a scanty vegetation, *Anacardium occidentale* fruits should be sown after lightly loosening the soil in patches 6 feet apart approximately. This species provides a useful fuel-wood and is eminently adapted to non-hospitable soils.

554. *Tending and climber-cutting.*—The entire coupe will receive a cleaning in the month of November following felling. This will involve (*a*) removal of climbers and obstructing weeds from coppice shoots, (*b*) a weeding around valuable seedlings and root-suckers in the interspaces not filled by coppice. This operation should be as liberal as funds will allow. It is particularly desirable that thorny scandent shrubs and climbing species be vigorously dealt with in the early stages, since in some localities they may later easily overwhelm large areas and get entirely out of control. In the artificially restocked blanks, the introduced plants will be favoured as a general rule, as against the coppice, except in so far as teak is concerned.

555. A cleaning and climber-cutting will be carried out, if necessary, in the second year after felling. In some coupes, particularly in the coastal reserves, or again when *Xylia* thicket is in abundance, such an operation is not prescribed, but in others (typified in Nerankimale reserve), it will almost certainly be required. Bamboo, if threatening coppice or seedlings, should be cut back to ground-level. Inferior species will be allowed to remain provided they do not actively interfere with the development of more important plants. Fast growing woody species, such as *Macaranga Roxburghii*. *Trema orientalis*, etc., should be retained in similar circumstances, as they tend to suppress weeds, but not over artificially restocked areas. Uprootal of lantana is not prescribed, as it appears to have been attempted without success in the past. Thinning out coppice shoots will be prescribed by the District Forest Officer to conform with the individual requirements of the crop in the several different localities.

556. Further special treatment of artificially restocked blanks is not prescribed. The beat-guard however should be made responsible, under the Range Officer, that such areas are not lost sight of nor neglected. They should receive attention and should be inspected from time to time by the Range Officer.

557. An inspection of the coupe by the District Forest Officer in the third year from formation is prescribed; he should note in the Control Journal any matters of interest and order special treatment at his discretion. A climber-cutting will be carried out five years after felling.

SECTION 8.—OTHER MISCELLANEOUS REGULATIONS.

558. All coupes will be closed for grazing and the exercise of concessions for five years after felling.

559. A survey of coupes will be done in January of the year preceding the felling. The number of the coupe and the year of working will be shown on coupe stones placed at the

corners of each coupe and at other prominent points adjoining roadways, etc. Coupes will be demarcated by lines cleared to a width of 10 feet before the coupe is sold, but they need not be subsequently maintained.

560. In view of the absence of competition for coupes and the low prices offered, no indicator strips will be prepared.

SECTION 9.—CONTROL.

561. The Control forms prescribed are—
(i) the Control Book,
(ii) the Record of Works,
(iii) the Control Journal.

Control forms will be personally maintained by the District Forest Officer. Sample entries are provided in Appendix II. An appropriate number of pages will be allotted to each felling series in the Control Book. Any coupe remaining unsold at the end of the year shall be brought forward into the appropriate column for the following year and sold instead of the coupe prescribed. Similar remarks apply to the keeping of the record of works. The Control Journal is a record of observations made by the District Forest Officer in the field.

CHAPTER VI.—WORKING PLAN FOR THE HOPEA IMPROVEMENT WORKING CIRCLE.

SECTION 1.—CONSTITUTION OF THE WORKING CIRCLE.

562. The areas allotted to this working circle contain *Hopea parviflora* in some profusion which will benefit from artificial assistance. The majority of the Hopea is in seedling and sapling stages. The patches are of irregular distribution and vary greatly in size. They are marked on the management maps in green hatching. The areas selected for working during the current period overlap other working circles. They are not the only such areas to be found in the division, but they represent sufficient at present for due cognizance and attention.

563. The combined areas of the patches total approximately 4,247 acres this being the gross extent of the working circle. The area computed as being actually occupied by young Hopea crops is however only 2,223 acres. The latter figure is considerably less than the gross area of the working circle owing to the fact in certain instances, e.g., Kidu reserve old "Hopea Improvement" coupes having already-defined boundaries have been included '*in toto*' for the sake of convenience. This is made clear in the special map of Kidu reserve (also vide paragraph 565).

564. *Valuation.*—No specific valuation can be given to the crops at present, but considered as areas already partly or wholly established with Hopea regeneration, their value on the criterion of artificially established plantations would not be less than Rs. 5 per acre, many localities being however far more valuable. Assuming that the acreage actually under Hopea is 2,800 acres, the present value of this crop on an average basis of Rs. 8 per acre is Rs. 22,400. It is therefore politic to spend some little money to improve the condition of these crops, since it is abundantly proved that the incidence of natural seedlings in a crop of this species diminishes very rapidly under adverse conditions, so that valuable crops are lost to posterity by neglect. These operations, provided they are conducted in accessible localities, would be more remunerative than the forming of new plantations where no regeneration of this species exists.

565. *Distribution of areas.*—The following table shows the present distribution of naturally-stocked Hopea areas, apart altogether from those in the Regeneration Area of the Timber Working Circle. The areas of Hopea patches shown in column (3) of the statement below correspond with the areas represented on the management maps, with the exception of those for Kidu block. This block has already been divided up into nine "improvement coupes" (vide paragraph 172) demarcated by cut lines. Only portions of these coupes actually contain Hopea, and the respective areas of these Hopea patches only are shown in the statement, not the gross areas of the "coupes" demarcated by the cut lines, which however are retained for the sake of convenience.

Range. (1)	Block. (2)	Area of. Hopea patches. (3)	Total in each range. (4)
Kasaragod	Kanakamajalu	128	
		38	
	Do.	141	
	Do.	128	845
	Aletti West	115	
	Aletti East	145	
	Do.	150	

Range. (1)	Block. (2)	Area of Hopea patches. (3)	Total in each range. (4)
		ACS.	ACS.
Puttur	Devachalla	102	775
	Do.	128	
	Balpa	30	
		90	
	Yenekal	120	
	Do.	77	
	Subrahmanya	77	
	Do.	151	
Uppinangady	Dharmastala	90	603
	Mundaji Extension 4	38	
	Do.	102	
	Shibaji	38	
	Kidu	50	
	Do.	45	
	Do.	170	
	Do.	52	
	Bhagimala	18	

SECTION 2.—PRESCRIPTIONS.

566. *Survey and demarcation.*—The approximate size and situation of each annual coupe is indicated on the management maps (1 inch to 1 mile scale) for each range. These coupes will be visited and properly surveyed and demarcated by a line 6 feet wide in the year prior to that in which the operation is due. A sketch of the coupe to scale 4 inches to 1 mile will be drawn in the District Forest Office and retained for record with the control forms prescribed. A copy will be kept also in the Range Office.

567. *Cycle of operations.*—Each of the coupes prescribed will be tended on a six-year cycle. The average size of the annual " coupe " during the first period will be 141 acres in Kasaragod Range, 129 acres in Puttur Range and 100 acres in Uppinangady Range.

568. *Method of treatment.*—No definite instructions are laid down, since conditions vary in the several coupes. The operations involve weeding, climber-cutting, cleaning, shade-removal, etc., according to the individual requirements of the crop in each locality. All such cultural operations have already been described in detail in the prescriptions given for Hopea treatment in Chapter II and their application will be a matter of common-sense. The area to be dealt with will probably fall into one or other of the following classes :—

(i) Natural Hopea regions under or adjacent to parent trees, the existing canopy being for the most part rather open. The height and density of the crop is most irregular. Certain areas have already been subjected to past treatment for the improvement of the young crop, and in some cases the Hopea is in urgent need of freeing from surrounding weed-growth. A cleaning, combined with a climber-cutting will serve in many of these localities.

(ii) Young Hopea crops established under the shade of a non-descript secondary regrowth from kumri, i.e., of reeds, climbers, small trees, etc. These areas are often found on the lower contours of hills containing parent trees along their crests. If the Hopea regeneration is sufficiently dense, the best course would be to cut lines about 8 feet wide through the area, spaced 20 feet apart, in the manner prescribed for second class areas (vide paragraph 380). All undergrowth and trees up to 25 feet height found on the lines should be removed, but top canopy must be retained. It is important when lines are cut in this manner to mark their positions by small cairns at convenient places so that they will not be lost sight of afterwards. If regeneration exists only in small groups it will probably be found more convenient to deal with each patch as a whole, neglecting the intervening spaces where regeneration is sparse.

(iii) Hopea seedlings established by wind or water-borne seed under the shade of deciduous high forest (as frequently seen along river-banks), or spread from nuclei of parent trees in the neighbourhood. The course of procedure must then depend upon the degree of advancement and light requirements of the young crop, the nature of obstructing vegetation, and the size of the patches to be tended. Again it is emphasised that removal of top canopy should be sparing, but low shade from small evergreen trees should be reduced considerably.

569. During the operations for the benefit of Hopea, other valuable associated species should not be overlooked ; species such as *Artocarpus hirsuta* should receive similar treatment.

570. The work described should be sufficiently intense to be of permanent value to the young Hopea crop, so that its growth for the next few years will be greatly stimulated, yet above all things it is necessary to avoid giving an opportunity for rank weeds to obtain a hold upon the areas thus treated in the interval before the next operation becomes due. Much former work of this nature has been nullified for this reason. No revenue can be expected from these operations and the work must accordingly be done as economically as possible. The Range Officer should himself superintend the early course of the work in each annual coupe.

571. In years of prolific seedfall, beat guards (where not otherwise employed on more important duties) should prepare and sow broadcast with Hopea seed suitable plots within their beats, not exceeding 2 acres in total extent in any one beat. Each plot should be ½—1 acre in extent. Moist deciduous or semi-evergreen tracts, preferably not occupied by good timber of other species, should be chosen; riverbanks and nullahs afford many suitable sites for these operations, which should not, however, be inconveniently removed from foot-paths whence they can be easily inspected. The localities chosen should be as accessible as possible. Undergrowth should not be so thick that the ground is hidden from sight, or if it is dense it must be cut to ground level and removed from the plot before sowing. Heavy quantities of undecomposed leaf-humus should also be removed. Collection of seed and preparation of the ground must be done by the forest guard without extra cost to the Department. The plots need not be accurately demarcated or surveyed, but the approximate locality of each plot with the year of sowing should be marked on the control maps.

SECTION 3.—CONTROL.

572. Specimen control forms are appended. Control maps for each range will be prepared to the scale of 4 inches to 1 mile, showing the annual coupes taken up in rotation, and the surveyed areas of each. Other valuable associates of Hopea such as *Artocarpus hirsuta* should be given similar treatment.

573. Tabular statement of fellings.

Year.	Range.	Reserve.	Compart-ment number.	Coupe number.	Area in acres.
(1)	(2)	(3)	(4)	(5)	(6)
1933-34	Kasaragod	Kanakamajalu	3	I	166
1934-35	Do.	Do.	2	II	141
1935-36	Do.	Do.	2	III	128
1936-37	Do.	Aletti, West	3	IV	115
1937-38	Do.	Aletti, East	2	V	145
1938-39	Do.	Do.	2	VI	150
1939-40	Do.	Kanakamajalu	3	I	166
1940-41	Do.	Do.	2	II	141
1941-42	Do.	Do.	2	III	128
1933-34	Puttur	Devachella	3	I	102
1934-35	Do.	Do.	3	II	128
1935-36	Do.	Balpa	4 and 5	III	120
1936-37	Do.	Yenekkal	6	IV	120
1937-38	Do.	Do.	6	V	77
1938-39	Do.	Subramanya	5	V	77
			6	VI	151
1939-40	Do.	Devachella	3	I	102
1940-41	Do.	Do.	3	II	128
1941-42	Do.	Balpa	4 and 5	III	120
1933-34	Uppinangady	Dharmastala	6	I	128
		Mundaje Extension 4.			
1934-35	Do.	Do.	6	II	102
		Shibaje	3	II	38
1935-36	Do.	Kidu	1	III	50
1936-37	Do.	Do.	1	IV	45
1937-38	Do.	Do.	2	V	170
1938-39	Do.	Do.	2	VI	52
		Bhagimali	1	VI	18
1939-40	Do.	Dharmastala	6	I	128
		Mundaje Extension 4.			
1940-41	Do.	Do.	6	II	102
		Shibaje	3	II	38
1941-42	Do.	Kidu	1	III	50

CHAPTER VII.—WORKING PLAN FOR THE PROTECTION WORKING CIRCLE.

SECTION 1.—CONSTITUTION OF THE WORKING CIRCLE.

574. *Area, constitution and brief description.*—The total area of this working circle as it stands at present is 196,069 acres. It covers all tracts of forest not directly provided for under the prescriptions of the foregoing working circles, and its constitution has been described in chapter 1 (paragraph 278). The vegetation is of every type and description. It includes almost the entire ghat range and all "inaccessible" jungles. In the plains

and foothills, all immature timber forest not at present proposed for inclusion in the Timber Working Circle for the next 60 years is included, as also reserves of degraded scrub, bamboo and small timber. Certain portions will undoubtedly in due course be taken up for intensive working, but in the meantime their purpose is purely protective.

SECTION 2.—VALUATION OF THE GROWING STOCK.

575. No enumerations have been conducted in these areas, but practically the entire extent has been stock-mapped to type, with the exception of small sections of ghat-forest, and a few minor scrub-type reserves. The stockmaps are on Survey of India sheets to the scale of 2 inches to 1 mile. On the management maps (scale 1 inch to 1 mile), the areas under this working circle have been left uncoloured, except those described in paragraphs 323 (*b*) and 578.

SECTION 3.—METHOD OF TREATMENT.

576. *Prescriptions.*—During the period of this plan, the Protection Working Circle will not be systematically worked except those portions prescribed under the Hopea Improvement Working Circle and those leased under the Minor Produce Working Circle. "Improvement fellings" are not prescribed for the crops of this working circle, for reasons stated in paragraph 428 but the management is not precluded from undertaking such works as may be deemed necessary from time to time, provided that some revenue is derived therefrom, and the operations carefully supervised. The prescriptions of paragraph 428 apply.

577. The cutting of woody climbers should be carried out annually by forest guards in their beats ; a minimum area of 50 acres should be completed by each guard annually.

578. In the management maps prepared for each range, certain areas are indicated as being the most suitable parts of this working circle for exploitation, should conditions justify it. These, shown hatched in red, will be reinspected and, if necessary, enumerated by the revising officer at the conclusion of the present period, if there should appear any necessity for incorporating further areas, now deemed inaccessible, in the Timber Working Circle for intensive working.

CHAPTER VIII.—WORKING PLAN FOR THE MINOR PRODUCE WORKING CIRCLE.

579. *Constitution of the working circle.*—This working circle covers the entire area of reserved forest in the division, and in addition, for the purposes of administration and control, the entire tract of Government waste lands, village poramboke, 'kumakies,' assessed kans and banes. The existing rules make it clear that the kumakidar is not entitled to alienate any of the privileges to which he is entitled, except along with the land to which they are attached. The possession of 'kumaki' privileges does not carry any right on the part of the kumakidar to profit directly by the sale or disposal of any part of the produce on his 'kumaki' which is not utilized by him for *bona fide* agricultural or domestic purposes within the village in which the land is situated. Minor produce on these lands is therefore separately leased out to purchasers, and is considered the property of the lessee, apart from that which the kumakidar himself requires for his own consumption. The lessee and the kumakidar must therefore come to terms of mutual arrangement with respect to the division of the produce. 'Banes' in the Sullia and Amara maganes are treated as 'kumakies,' and assessed kans are similarly considered except with respect to the specific produce for which the annual 'kist' is paid.

580. *Method of sale.*—Owing to the intimate territorial relationship which exists between 'kumakies' unassessed waste land belonging to Government and Government reserved forest, arbitrary discrimination of the produce by sale of separate leases would be inconvenient to all parties, and the existing arrangement, whereby the above lands in the entire revenue administration within the boundaries of South Mangalore Forest Division are parcelled out into convenient-sized farms for annual auction, is retained in the present plan. The control of these farms, so far as reserved forest is concerned, will rest with the Department, and it will be within the powers of the District Forest Officer to close or exclude any block of forest from the terms of the lease, such blocks being clearly named and defined in the notification prior to sale. The District Forest Officer may likewise, under existing arrangements, sell by separate agreement the specific produce of any block named by him, in any way that he may think fit. The Revenue Department will conduct the sales, and be responsible for the collection of revenue, but the sales will be confirmed by the District Forest Officer who will also scrutinize and approve the agreements executed by the contractors concerned. He should also watch the collection of revenue in the tahsildars' returns, and cancel any lease in the event of default.

581. *General lease of minor produce.*—The following minor produce shall be sold annually in auction for the period commencing on the 1st July and ending on 30th June for each of the several ' farms ' notified in the District Gazette :—

Cardamoms (except in leased areas), soapnut, wild mace, cashewnuts, nuxvomica seed and fruits of all kinds, pepper (except in assessed kans), natural gums and resins, honey, wax, myrabolams, cinnamon flowers (except of thej and kadwa species), ginger, bones (but not elephant tusks), roots, canes (except ' Naga ' canes), ' kadushige ' bark, fibres and reeds (but not bamboos). Horns and skins shall not be leased. Other items may be specified in the list should there be a demand. A clause shall be inserted in the lease dealing with the collection of canes, that removal of the rhizome or any part of the root-system is prohibited, and that contractors must cut the cane cleanly above ground level. At present there appears to be no need to limit the cutting of ordinary rattans and canes which exist in profusion. Certain families of Malekudies, who live by basket-making obtain separate licences for cane collection.

582. *Naga canes.*—This species of spotted cane is much in demand on the coast at Tellicherry and is found chiefly in the localities of Kiribag and Subrahmania. It has been so heavily worked in the past and with such damage to the rhizomes, that the species is now in danger of extinction, and it is prescribed that this product shall not be leased for the next five years at least, and until the District Forest Officer is satisfied that the species has again recovered sufficiently in abundance to permit of further extraction. Future leases shall enforce stringent protection of the root-systems, and all canes extracted shall be carefully inspected to see that only the cane has been cut, and not the root. This product is best leased under separate agreement with the District Forest Officer, and the lease should be given in alternate years in the first instance, but if there is any danger of the supply becoming again exhausted, the lease will be given in every third year.

583. *Cardamoms.*—Cultivation of cardamoms is carried on under long-term leases which extend usually for 30 to 40 years. Small further development of this industry is anticipated until prices again appreciate and the market becomes steady. The localities particularly in request are in heavy ghat jungles between 1,500 and 3,000 feet elevations. These localities rarely contain timber species of value, or if so, they are in inadequate numbers to justify extraction from difficult country. The requirements of the cardamom plant ensure that no excessive opening up of the forest thus leased is possible without detriment to the crop, but in any case the terms of the lease should specify in each instance the minimum number of trees which should be left per acre (having regard to the situation) and those species the felling of which is prohibited.

The District Forest Officer will use his discretion in the grant of further leases for cardamom cultivation. There appears to be small argument against the further extension of this industry in the more inaccessible ghat regions, should there be a demand.

584. *Wood-oil.*—The lease for tapping wood-oil from *Hardwickia pinnata* trees is granted biennially. No precise data are on record to enable us to determine what alternate periods of tapping and of rest are desirable. From casual inspection the trees do not appear to have suffered conspicuously by past treatment. In default of definite knowledge to the contrary, it is thought that short alternate periods of working and rest are of as much value as longer periods, if not more so, since the original wound can be easily reopened after a short rest, which is probably preferable to making fresh wounds in the cambium each time. The lease of this product in alternate years is accordingly prescribed, unless it becomes evident from experience that a longer period of rest is desirable.

585. *Cinnamon.*—The three varieties of *Cinnamomum* used locally for the distillation of cinnamon oil are known as ' kara ' (pungent), ' kadwa ' (bitter), and ' theja.' The specific identification of these three is not certain. They have been matched tentatively as *Cinnamomum zeylanicum*, *Cinnamomum riparium* and *Cinnamomum iners*, respectively. Other varieties, probably of *Cinnamomum zeylanicum*, are found in the district ; *Cinnamomum camphorum* is abundant in Bantamale reserve but is not utilized. Local practice is to distil the leaves and buds in crude retorts or stills, the lease being granted separately for this product and not along with the general lease. It is unlikely that any advance upon present methods of distillation can be secured unless active steps be taken by the Forest Department itself. In Ceylon, the industry has reached an advanced state of organized efficiency. In that country, *Cinnamomum* is grown exclusively for bark production. The best species for this purpose are grown in Ceylon in a very sandy clay or fine white quartz sand overlying a rich subsoil. The nearest approach to this kind of soil in South Kanara is probably to be found along river banks. Laterite gravel is said to produce a quicker but coarser growth, and marshy soil imparts an undesirable bitterness to the product. The climate of South Kanara appears to be suitable. It is therefore prescribed that during the period of this plan, experiment be made first of all to utilize the *bark* of

our own indigenous varities ; secondly, to attempt the introduction of Ceylon varieties in various localities ; thirdly, to take initial steps, organized departmentally, in the collection of bark, distillation of oil, and marketing of the product. Full particulars of the Ceylon industry are available in leaflet No. 51 of the Ceylon Department of Agriculture, and in the Bulletin of the Imperial Institute, Volume XIX, No. 3.

586. The first step to be taken in the more effective utilization of local varieties is to cut specimen shoots, about two years old, from the 'kadwa' and 'theja' varieties after the first early showers of May. The bark should be stripped carefully from these shoots in a longitudinal direction, heaped together and kept moist for a day or two, after which the pulpy hypoderm should be scraped off and the bark sent to Dehra Dun for analysis and comparison with the varieties already used in commercial distillation.

587. Should the report indicate prospects of further development, steps should next be taken to collect and prepare sufficient bark to market it in order to see whether an organized trade in the produce can be established in South Kanara. The matter is best conducted through the agency of the Forest Utilization Officer, Madras, in the first place ; but local Mangalore firms such as Messrs. Peirce Leslie & Co., would doubtless take up this agency if an assured market and sustained supply were established.

588. In the meantime, Ceylon seed should be experimented with in a prepared and shaded nursery. Adult trees fruit in Ceylon in the month of July, and at this season it might be possible to secure good seed without its losing germinative properties. Particular care should be asked for in the packing and expeditious transit of the seed, which should be sown immediately on receipt. If germination is successful, the plants should be transplanted, a few at three months old and the remainder at twelve months, into staked and prepared patches 9 feet apart on suitable, deep, well-drained light loamy soil, which should be kept weeded. River-bank conditions are probably the best which can be got, but not those in heavy evergreen or sub-evergreen surroundings. Other localities might subsequently be chosen, if there appear grounds for continuing the experiment. Exposure to direct sunlight is said to produce the best quality of bark, but in early experimental stages it is better to proceed cautiously in the opening of canopy, as is done in the case of *Hopea parviflora*, although with greater freedom since the growth should be more rapid. No further prescriptions beyond these experiments are at present indicated, but the high annual returns obtained from cinnamon planting in Ceylon, which possesses similar climatic conditions to those of Kanara, would point to the desirability for connected observations being conducted with a view to the expansion of this remunerative industry in the Madras Presidency, if at all possible.

589. *Cashewnuts* (*Anacardium occidentale*).—The export of these nuts has found progressively increasing markets, particularly in America, during the past five or six years, and the prevailing slump has hitherto not greatly affected their sale. The extraction of a valuable oil from the husk has hitherto been hampered only by the lack of suitable machinery, investigations for the perfection of which are in progress. Private enterprise is closely following up development of this product by American firms, both along the West Coast of India and in Africa. It is doubtful whether the Forest Department can, or should, compete in this field on any extensive scale, yet the readiness with which this species may be raised on poor quality soils renders its propagation exceptionally easy, and the attention it requires is practically nil. A prescription has been made (paragraph 553) that it should be sown in laterite blanks, in fuel areas, as it is also a good fuel species. Extensive plantations of this tree are not prescribed. The progress of the demand for the cashewnut should be watched, and the management should increase the acreage under this species, particularly in Kasaragod Range, if by so doing the value of the minor produce leases can be perceptibly enhanced in future. The tree begins to bear fruit after four or five years. The majority is at present in unreserves.

590. *Control.*—The produce from each of the leased "farms" shall be entered in the Record of Works, a specimen form of which is given in Appendix II.

CHAPTER IX.—WORKING PLAN FOR THE SANDAL WORKING CIRCLE.

SECTION 1.—GENERAL CONSTITUTION OF THE WORKING CIRCLE AND CHARACTER OF THE VEGETATION.

591. All village lands where sandal is present either in unreserves, kumakies or patta lands are included in this working circle. The general distribution of sandal is unequal and sparse, and the species is confined to the coastal and the plains areas of the division. It occurs in degraded timber areas of the deciduous type, generally on outer slopes of hills, in pockets near the source of streamlets and in minor nullahs and valleys which contain mediocre but not heavy vegetation. It is conspicuously absent from the margins of principal rivers, open grassy hill tops and fairly thickly wooded forest areas of the plains. Occasional saplings and trees are found in coastal reserves of the fuel type and in lightly wooded

localities, which have incompletely recovered from past clearances, such as Adhur, Bantaje and Kalanjimale blocks. Generally its main habitat may be said to be village lands, which are remote from reserved forests. In South Kanara, sandal is not essentially a forest tree and consequently it has received little systematic attention from the Forest Department. Owing to the diffuse nature of the distribution of sandal in lands which are remote from the reserved forests of the division and which are not under the direct administrative control of the District Forest Officer, no detailed stockmapping or valuation of the sandal areas was undertaken during the preparation of this plan. However, with the data available from past exploitation operations in the unreserves, the sandal bearing areas of the division have been, as far as possible, shown on the maps accompanying this report. It is possible that certain village lands outside the limits of the working circle, as shown in the maps, may be found to contain sandal. Such lands should also be brought under exploitation and the procedure to be followed in such cases is prescribed in a later paragraph. Therefore, the limits of the working circle are only tentatively defined and discretion is allowed to the management to add further sandal areas should any be found.

Excluding the reserves where the occurrence of sandal is negligible, the lands included in this working circle may be classified under the following categories :—

(*a*) Unreserves,
(*b*) Kumaki lands, and
(*c*) Patta lands.

Government hold absolute proprietary rights over sandal occurring in unreserves and kumaki lands ; but in the latter case, a concession has been extended to the kumakidar in G.O. No. 1461 (Development), dated 4th November 1922, whereby one-third of the value of the sandal trees at the seigniorage rates in force is to be paid to the kumakidar, as remuneration for the protection afforded by him to the trees, when they are extracted by the Forest Department. Sandal trees on patta lands are the absolute property of the pattadars.

From the data avilable it is reckoned that the total area of villages containing sandal is 60,538 acres in Kasaragod Range, 8,859 acres in Puttur Range and 13,240 acres in Uppinangady Range, or in all 82,677 acres. Of the above totals, approximately one-quarter of the area in Kasaragod Range contains scattered sandal trees, and about one-tenth of the area in each of the other ranges. The total area of village lands which contain sandal is therefore about 16,000 acres. These figures have been obtained from a brief reconnaissance made in 1930 and from data supplied by the Range Officers.

In Kasaragod Range the growth of sandal appears a trifle better than that of North Mangalore Division, but the greater part is inferior to that found in the more important sandal divisions of the Presidency. Hard laterite soil appears uncongenial to good growth ; trees are stunted and often stag-headed. Trees in kumaki lands are superior to those in waste lands partly owing to more favourable soil conditions and partly to a certain amount of protection afforded them by kumakidars. Reports after chemical analysis of sample billets sent to the Forest Research Institute, Dehra Dun, show that the oil content of South Kanara sandal is superior to that found in samples sent from most other districts, and there appears small doubt that if sandal were systematically raised in selected localities and afforded proper protection, a very much improved stock of this species fetching satisfactory prices, would be realized.

Two felling series have been constituted ; the Kasaragod Felling Series and the Puttur-Uppinangady Felling Series. The absence of adequate data precludes possibilities of division of the sandal areas into more felling series.

Section 2.—Valuation of the Growing Stock.

592. For reasons already stated enumerations of sandal trees have not been made during the preparation of this plan. An enumeration was made by the district in 1926, the results of which are recorded in the tables accompanying this section. The following table gives an abstract of the total number of trees enumerated in 1926 and the balance avilable now for working :—

Range.	Number of trees enumerated in 1926.		Total trees extracted up to 1930–31.	Balance remaining.
	Under 15″ girth.	Over 15″ girth.		
(1)	(2)	(3)	(4)	(5)
Kasaragod	5,348	403	1,150	4,601
Puttur	65	36	48	53
Uppinangady	272 (total).	..	138	134

It is clear from the above figures that Kasaragod Range alone affords any prospect of continuous working for the near future.

Sandalwood villages—Results of enumeration (1926).

Serial number.	Village number.	Villages.	Trees over 6″ in girth as given by Tahsildar.	Trees enumerated by the Forest Department. Under 15″.	Over 15″.	Total trees uprooted till 1930–31.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
		KASARAGOD RANGE.				
1	3	Vorkadi	12	58	14	..
2	11	Minja	320	602	13	9
3	13	Kulur	327	434	7	..
4	27	Kaiyar	128	1,396	19	182
5	28	Paivalkie	387	554	13	2
6	29	Chippar	53	79	..	..
7	30	Bayar	2,250	..	80	174
8	31	Kudalmerkala	68	312	2	42
9	38	Ednad	6	..	..	..
10	46	Padre	14	26	13	23
11	50	Kumbadaje	54	402	63	71
12	51	Ubrangala	39	275	51	50
13	53	Bela	189	116	33	93
14	54	Madhur	44	211	8	13
15	55	Patla	25	28	..	..
16	64	Muttathodi	622	449	31	9
17	60	Kudlu	135	..	..	..
18	65	Chengala	300	83	..	..
19	67	Nekraje	30	163	31	6
20	68	Muliyar	45	160	25	8
21	70	Adur	1,174	..	..	283
22	76	Tekkila	30	..	..	..
23	78	Perambale	17	..	..	..
24	174	Panaje	..	..	..	69
25	176	Nidpalli	..	..	..	122
		Total ..	6,269	5,348	403	1,159
		PUTTUR RANGE.				
1	161	Vitla		33	4	33
2	39	Kodipadi		6	11	12
3	48	Balanadu		26	21	..
		UPPINANGADY RANGE.				
1	45	Narimogar		..	..	60
2	44	Bhantigod		..	..	65
3	43	Chickmugunur		..	..	3
4	88	Kankradi		..	..	10
		Total		65	36	186

Further enumerations of sandal in the unreserves and kumakis of this division are now being made by the district staff, and results will, it is reported be ready shortly.

SECTION 3.—METHOD OF TREATMENT.

593. A brief outline of the policy of the Department in the past is essential for a comprehensive understanding of the method of treatment prescribed in the following paragraphs :—

It is a common practice for private merchants to transport sandalwood from Mysore and Coorg to South Kanara for the purpose of distillation of the essential oil ; this has in the past afforded facilities for thieves to remove illicitly large quantities of sandal from the Government lands of the district. Further, legitimate purchase of sandal in patta lands has also been used as a cloak for the theft of Government sandal especially from unreserves.

In 1915 special rules for the transit of sandal in South Kanara were introduced. These rules, however, sought merely to control the movement of sandalwood and were not concerned with the prevention of illicit felling in unreserves, the protection of which is vested in the Revenue Department. Large scale thefts have continued in spite of the special transit rules.

In 1922, on the recommendation of the Chief Conservator of Forests, Government approved the policy of encouraging sandal in kumaki lands and ordered in G.O. No. 1461, Development, dated 4th November 1922, the grant of remuneration to kumakidars for fostering the sandal trees till they were exploited by the Forest Department.

In 1925, the kumakidars represented that the responsibilities attendant on the conservation of sandal on kumaki lands were a serious burden. On the recommendation of the Chief Conservator of Forests, Government, in their order Mis. No. 891, Development, dated

18th June 1925, considered it inadvisable to continue the policy of encouraging sandal in kumaki lands and directed that sandal trees on such lands should be uprooted and sold in auction. The Chief Conservator, however, ordered that trees that did not contain heartwood need not be uprooted. Consequently, from 1925 extraction of sandal from unreserves and kumakies was confined to trees of and above 10 inches in girth, it being presumed that trees below 10 inches do not contain heartwood.

The control of private sandal was never attempted by the Department in the past; therefore no patta sandal extraction was undertaken.

Until 1925 no tree value on sandal trees was collected from kumaki lands assigned on patta although the sandal trees on kumakies are the absolute property of the State. After 1925, it was the practice to recover two-thirds of the value of the sandal trees at seigniorage rates on lands assigned on patta. At the instance of the District Forest Officer and the Collector, Government in their order No. 885, Revenue, dated 19th April 1928, approved the recommendation of the Board of Revenue that this practice should be regularized.

The seigniorage rates referred to in the G.O. No. 1461, Development, dated 4th November 1922, were revised in Chief Conservator's Proceedings Mis. No. 663, dated 27th December 1930, and Mis. No. 150, dated 13th April 1931, in consultation with the Collector. The new rates were based on the actual heartwood content of the trees extracted in the past and their net money value after deducting cost of marketting.

It will thus be seen that till 1930, when the present Chief Conservator modified the policy, it had been the practice of Government to alienate sandal trees on lands assigned on darkhast. The recognition of private rights to sandal has been an important factor in the increase of sandal smuggling in the district. In order to prevent theft, the Chief Conservator of Forests, in 1930 decided to put an end to the practice of allowing darkhastdars to purchase sandal from Government on darkhast lands and ordered the removal of all sandal trees on such lands before assignment (vide Chief Conservator's Proceedings No. 663, dated 27th December 1930, as modified by Chief Conservator's Proceedings Mis. No. 150, dated 13th April 1931). This order prescribed that the policy to be adopted was to remove through the agency of the Forest Department, *all* sandal on kumaki lands to be assigned on patta, though a scale of seigniorage rates to be adopted was fixed to cover cases where it might not be possible or desirable to remove the sandal trees prior to assignment.

While it has been the policy in South Kanara to allow pattadars to acquire possession of sandal trees in patta lands, in other and more important sandal districts, it has always been the intention of Government to reserve to themselves the ownership of sandal trees in assigned lands. In G.O. No. 1290, Revenue, dated 16th June 1928, Government have made the reservation of existing and future sandal trees a condition of the grant of lands in certain special sandal tracts. It would be desirable to extend the operation of this Government Order to South Kanara, so that, in the future, the existence of privately owned sandal may not embarass Government.

The following is a brief analysis of the legal points relating to sandal on different classes of lands in this division :—

(1) Government hold absolute ownership of all sandal trees on reserves and unreserves.

(2) All sandal trees on kumaki lands are the absolute property of the State, but when extraction of sandal is undertaken by the Forest Department, the kumakidar is to be remunerated at one-third of the seigniorage rates on *all* sandal trees containing heartwood as ordered in G.O. No. 1461, Development, dated 4th November 1922. The seigniorage rate has been revised in Chief Conservator's Proceedings Mis. No. 150, dated 13th April 1931.

(3) When kumaki lands containing sandal are assigned on darkhast, the Forest Department may extract all the sandal trees before assignment and pay the kumakidar compensation according to the rates laid down by the Chief Conservator of Forests from time to time.

(4) On patta lands, Government have at present no right over sandal trees.

594. *Outline of future policy.*—The following considerations indicate the advisability of continuing the policy adopted since 1925–26, viz., that of removal of all sandal trees containing an appreciable quantity of heartwood from unreserves and kumakies :—

(1) Such lands are not under the direct administrative control of the Forest Department.

(2) Sylvicultural operations should not be undertaken on village lands which are primarily reserved for the benefit of the villagers. The department must therefore be content with exploiting the sandal which nature has provided in the villages.

(3) South Kanara is not essentially a sandal district. Sandal occurs scattered over the waste lands and kumakies of the more open type of forest remote from the reserves, and it is not the function of the Forest Department to attempt to protect or foster the sandal trees on such lands.

(4) The presence of private sandal oil stills in the district provides an incentive, and the existence of privately owned patta sandal serves as a convenient cloak, for the illicit removal of Government sandal. To prevent theft the only effective method seems to be to remove all sandal containing exploitable heartwood that are not under the direct control of the Forest Department ; this should include all sandal on patta lands as well as in unreserves and kumakies.

Therefore the objects of future management should be :—

(1) to extract systematically at frequent intervals, all sandal trees of and above a prescribed girth limit from unreserves and kumaki lands,

(2) to offer to purchase, as a measure of protection, all sandal trees containing exploitable heartwood on patta lands under suitable agreements, and

(3) to remove from darkhast lands, prior to assignment, all sandal trees containing hearwtood that it is profitable to extract, and thereafter to remove sandal growths thereon, from time to time, as it becomes economically exploitable.

595. *Prescriptions.*—In unreserves and kumaki lands, all living sandal trees of and above a girth of 10 inches, and all dead trees and stumps containing heartwood, shall be extracted. For sandal trees containing heartwood extracted from kumaki lands remuneration shall be paid to the kumakidar according to the rates laid down by the Chief Conservator of Forests from time to time. A girth limit of 10 inches is adopted as it is the estimated minimum size which will yield heartwood that can be extracted economically.

Attempts should be made to purchase sandal trees containing heartwood on patta lands when the owner (and care must be exercised to ensure that the trees are privately owned) desires to exploit them. The most satisfactory plan will be to ascertain what of such trees exist and to enter into agreements with the owner providing for extraction by the Forest Department upon terms to be mutually agreed upon. The basis of payment will be the rates obtained for departmentally exploited wood less the actual cost of extraction less five per cent of the gross sale proceeds.

Notice of the policy adopted should be announced from time to time in the District Gazette when it is likely to be found that private owners will prefer to sell to the Department rather than to private dealers. Exploitation of such trees must be done when it is desired by the private owner, proper accounts must be rendered to him and payment, which should be as prompt as possible, should be made by the District Forest Officer.

In sandal bearing unreserve lands all the sandal trees containing heartwood that it is profitable to extract shall be removed by the Forest Department before the land is assigned on darkhast. When kumaki lands containing sandal are assigned the Forest Department shall similarly, before assignment, remove all sandal trees containing heartwood that it is profitable to extract and pay the kumakidar compensation according to the rates laid down by the Chief Conservator of Forests from time to time. Thereafter the Forest Department shall remove sandal growth thereon as it becomes economically exploitable. The Collector will give the District Forest Officer timely notice of application for the assignment of kumaki unreserve lands containing sandal so that the District Forest Officer may arrange to remove the sandal trees before the lands are assigned (vide Board of Revenue Reference B. No. 1362/29-5, dated 6th November 1929).

596. *Felling cycle.*—To meet the conditions in South Kanara an annual felling cycle would be ideal so that the whole area might be gone over every year. The scattered nature of the sandal, which covers vast areas of village lands, has, however, necessarily led to the adoption of a longer felling cycle. A felling cycle of six years is, therefore, prescribed.

The working will be regulated by area. A rough estimate places the available quantity of sandalwood yet to be extracted from Kasaragod Range at between 25 and 30 tons. The sandalwood villages of Puttur and Uppinangady Ranges are not expected, after recent extraction, to contain trees of exploitable dimensions at present, and accordingly they will not again be worked over until 1936–42.

597. *Method of working.*—The rules published in 1930 for the uprootal, cleaning, extraction and checking of sandal, modelled on the 'Javadi Rules,' shall be followed, subject to the special prescriptions laid down in this plan, and subject to the condition that the special method of classification adopted in South Kanara shall be continued.

One coupe shall be worked every year in the sequence laid down in the statement of fellings given below. All unreserves and kumaki lands included within the annual coupe and all patta lands which are situated in the annual coupe and in respect of which agreements have been executed shall be exploited in the year the coupe is due for felling. Should the area of the annual coupe be found too large for working, it may be divided into a suitable number of sub-coupes. Enumeration records shall be maintained separately for each sub-coupe as well as for kumaki lands and each survey number of patta lands.

Patta lands or unreserves containing sandal, which are outside the limits of the working circle as shown at present in the map, shall be included for extraction by allocating such areas to one or more conveniently situated coupes at the discretion of the District Forest Officer.

All lands which are newly proposed for assignment, if they contain sandal, shall be gone over by the Forest Department and all sandal trees on them shall be extracted before assignment, irrespective of whether such lands occur within the annual coupe or not. In the case of lands for assignment which lie outside the annual sandal coupe, the District Forest Officer shall make such arrangements as are necessary to have the sandal trees extracted at once. It is not anticipated that there will be so many new assignments of lands in any one year as to make this extraction work unduly complicated.

The District Forest Officer shall take early steps to address the Collector, on the subject of the execution of the agreements referred to above in respect of sandal on patta lands.

SECTION 4.—TABULAR STATEMENT OF WORKING.

598. The following table shows the order of villages prescribed for working. Two felling series are formed :—

(i) The Kasaragod Felling Series, containing 25 villages ; and

(ii) The Puttur–Uppinangady Series, containing seven villages.

Fellings will be conducted on a six-year cycle.

Kasaragod Felling Series.

Coupe number.	Year of working.	Villages.
I	1932–33	Nidpalli.
II	1933–34	Chengala. Perambale. Tekkila. Ednad. Patla. Bela.
III	1934–35	Vorkadi. Kulur. Chippru. Minja. Paivalkie.
IV	1935–36	Kaiyar. Kundalmerkala. Baiyar.

Kasaragod Felling Series—cont.

Coupe number.	Year of working.	Villages.
V	1936–37	Adur. Kudlu. Muttathodi. Madru. Nekmuraje. Muliyar.
VI	1937–38	Kumbadaje. Ubrangala. Panaje. Padre.

Puttur-Uppinangady Felling Series.

Coupe number.	Year of working.	Villages.
I	1936–37	Balanadu.
II	1937–38	Vitla.
III	1938–39	Kodipadi. Chickmugunur.
IV	1939–40	Narimogar.
V	1940–41	Shantigod.
VI	1941–42	Kaukradi.

SECTION 5.—ESTABLISHMENT OF SANDAL PROPAGATION CENTRES IN RESERVED FORESTS.

599. Propagation of sandal will be carried out in certain reserves only, which are specified below. The object of this work is to improve the value of the stock in the reserves which are at present valueless as timber producers and unlikely to command any great demand for extraction of fuel. These reserves can be easily protected, and theft is comparatively difficult. The soil should prove moderately congenial to sandal, and there are ample hosts. Exclusion of cattle is not contemplated, but propagation centres should be adequately fenced, as damage by cattle and wild animals is anticipated. In the majority

of cases, little damage is to be feared from the former as grazing incidence is slight, but deer and bison are always harmful to young sandal. The reserves selected are named below :—

	Area of reserve in acres.
(i) *Kasaragod Range.*	
Adur Reserved Forest	5,073
Muliyar Reserved Forest	2,116
(ii) *Puttur Range.*	
Balleri Reserved Forest	3,264
Kalanjimale Reserved Forest	1,560·9
Virakhamba Reserved Forest	1,449·6
(iii) *Uppinangady Range.*	
Kunthur Reserved Forest	3,869·5
Dondalarabi Reserved Forest	1,016·3

600. *Method of establishing propagation centres.*—The forest guard in charge of each of the above reserves shall prepare annually ten " nuclei of propagation " in favourable situations under light shade afforded by suitable hosts. The size of the propagation centres found most suitable is 12 feet by 12 feet. Each propagation centre or nucleus shall be properly prepared as detailed below and sandal seed shall be sown therein in the latter end of April, or planted at the outbreak of the monsoon. Each reserve named shall be worked over compartment by compartment.

601. A method of establishing sandal propagation centres which has achieved satisfactory results is described below, and the operations should be carried out in the manner described.

602. (*a*) *Preparation of nuclei.*—Localities chosen should be moderately moist but well-drained, containing some humus loam. Hard laterite soil does not appear congenial. The vicinity of stream-beds affords suitable sites as birds congregate there and help to distribute seeds, as also does flood-water. There should be vigorous trees growing in the vicinity and the vegetation should afford shade without being too dense. Evergreen surroundings should be avoided. Lateral shade is essential, as also is overhead light. In the middle of a clump of trees, or on the shadiest side of them, a space about 12 feet in diameter should be cleared in February or March and the slash burnt over the spot. The ash is mixed with the soil.

603. (*b*) *Sowing.*—In these centres, at intervals of about three feet apart, shallow saucer-like depressions should be scraped up. A layer of whole seeds, about 10 or 12 in number, is placed over the worked soil and then covered with damp straw. The dumps will be only a few inches in diameter and about half an inch in depth. If the seed is discovered to be eaten subsequently by rats or vermin, the damage may be lessened by the removal of the outer skin and pulp of the seeds before sowing. About sixteen such dumps should be sufficient at each centre selected. If too many seeds germinate in the dumps, surplus seedlings may be readily transplanted during the monsoon. Care must be taken not to plant or sow the sandal too close to a host which may develop into a tree. Such should be at a minimum of three to six feet from any sandal seedling, or in later years the two will interfere with each other's growth.

604. (*c*) As immediate hosts to the germinating seedlings, dhall and *Dodonea viscosa,* shall be sown in rings around each dump.

605. (*d*) All propagation centres must be fenced with bamboo or similar material to a height of five or six feet. In grassy areas, the grass should be scarped to a distance of 10 or 12 feet all round the outside of the fence at the beginning of the fire-season and kept clear.

606. (*e*) Dumps should be watered twice a week, but not oftener, only if the hot-weather season is unduly prolonged without rain; for this reason the proximity of streams is desirable. No watering should be done if it can possibly be avoided.

607. (*f*) To provide against the possibility of failure of germination by the above method, each guard shall raise sandal in baskets with a shrub host such as *Dodonea viscosa* or dhall, in each, in or near his quarters where they can be watered and tended. These baskets with the seedlings can then be planted out in the prepared propagation centres when the monsoon has started if casualities have to be replaced.

608. (*g*) In the second and third years, special shading by means of wickerwork baskets constructed *in situ* may be necessary in exceptional cases, but if the centres are judicially chosen in the first instance, this should generally be unnecessary.

609. (*h*) Where soil is heavy, aeration by occasional forking is advisable if the plant does not appear to be thriving. But great care must be taken not to disturb possible root connections.

610. In the reserves of Adur and Muliyar where Lantana has infested certain areas, it is open to the management to attempt to instal sandal along with field crops grown by kumridars, and with dhall sown in rings around the sandal. Sandal sowing in such cases must be entirely in the hands of the Department. Such measures are not however prescribed for the immediate future until the working of adjoining kumries for timber is regularized, and supervision can conveniently be given to this work.

Section 6.—Control.

611. The following records will be maintained by the District Forest Officer :—

(*a*) The Control Book,

(*b*) The Record of Works,

(*c*) The Control Map.

Sample forms are given in Appendix II.

CHAPTER X.—MISCELLANEOUS PRESCRIPTIONS.

Administrative Changes.

612. Certain modifications in the existing distribution of reserves within executive charges will be effected from the date of sanction of this plan.

613. *Beltangady Range.*—Reference to the figures of past revenue and expenditure in Beltangady Range, printed in Part I of this plan, shows that the transactions of this range are insignificant compared with those of the other three ranges of the district. No extensive exploitation of the forests of the northern part of the district is contemplated during the forthcoming period, and the work will be mainly protective. This range will be abolished as a separate range charge.

614. The adjoining Mangalore Range of North Mangalore Division, for which a working plan is now under construction, is similarly a very light administrative charge, of which there is small justification. It is therefore prescribed that the tract now comprising Beltangady Range be divided up between Mangalore Range on the north and Uppidangady Range on the south. The tract of forest to the north of the Beltangady-Charmady Ghat Local Fund road, i.e., Charmady-Kanapady reserve (part), area 8,866 acres and Naravi reserve (part) area 28,411 acres, but excepting Mundaje Kap reserve will be apportioned to Mangalore Range of North Mangalore Division. The last-named reserve, which contains Hopea plantations under shelter-wood, and the remaining reserves of Beltangady Range south of the Local Fund road will be absorbed into Uppinangady Range of South Mangalore Division. All the tracts now transferred to Mangalore Range are easily accessible from Mudabidri, the headquarters of that range, by metalled road. The advisability of re-opening Beltangady Range when intensive operations are contemplated therein, will be considered at some future revision.

615. *Uppinangady Range.*—The following reserves are transferred to this range from Beltangady :—

	ACS.
Charmady-Kanapady (part)	4,998·00
Mundaje Kap	476·20
Miyar	14,496·88
Nidle	3,258·00
Dadanthamale	2,342·40
Dharmastala-Mundaje and Extension	6,415·22
Dondalarabi	1,016·30

616. *Puttur Range.*—The following reserves are transferred to this range :—

Jalsur East	807·68	transferred from Kasaragod Range.
Jalsur West	2,223·36	
Anegundi	3,347·84	
Narimogar	1,445·10	transferred from Uppinangady Range.

617. *Kasaragod Range.*—The following reserves are transferred from Puttur Range to Kasaragod Range :—

		ACS.
Sampaje	.. ..	11,949·56
Thodikan	.. ..	2,858·88
Pumale	.. ..	4,871·68

Roads and Buildings.

A. Roads.

618. All existing permanent forest roads should be maintained to such extent as will prevent their falling into undue disrepair. Bridges and culverts will be kept in good order. Roads not employed for the purposes of current exploitation require chiefly that drains be kept well-cleared each year, to prevent scouring away of surface material during successive monsoons ; tendencies for heavy wash along the crown of the road should be arrested.

619. All inspection paths and roads should be cleared annually. Temporary cart-tracks will be constructed to serve the extraction of timber from coupes, and to minimize elephant dragging. They will be laid out in the most economical manner with reference to the topography of the coupe, and so constructed that their extension, if necessary, into later adjoining coupes is easily possible. Proper survey and alignment in the first instance is not essential except when it is necessary to plan in advance an effective road system for tapping an entire block or topographical unit for exploitation over several years. Low-lying or swampy ground should be avoided, as these roads will have merely a mud surface. On the other hand expensive earth cuttings and blasting of rocky outcrops on hill sides should be avoided as far as practicable and the alignment will to such an extent as possible be taken over gently sloping ground at or near the foot of hill slopes. After temporary roads have served their purpose for the time being they may require only a clearance of vegetation from time to time. They should ordinarily be kept open as inspection paths, and if leading into extensive blocks it would be convenient to keep them motorable for some distance and to regard that section as permanent road. Their use will again be required during the next felling cycle. Extraction roads will occasionally need to be taken through private warga-land in order to join public or main thoroughfares. Wet patta-lands should be avoided, but it is anticipated that as a general rule land-owners will readily agree to the construction of such roads through their property in their own interests, and acquisition of land should be unnecessary. In such cases fully attested agreements must be drawn up and signed by the parties concerned before the roads are made. No legal objections are anticipated where roads are led through kans, banes and kumakies, provided that the legitimate interests of owners are not prejudiced thereby.

620. The construction of permanent forest roads during the initial period of the plan is postponed by the policy of exploitation of unreserved and waste lands which will intervene for several years prior to the resumption of timber extraction from reserved forests. The actual year of construction of such roads is accordingly left indefinite, but the number of the coupe or coupes for which the road will be required is stated. During the decade 1932–41, few new roads will require to be constructed. Certain existing cart-tracks will require improvement during the course of opening up coupes prescribed ; others are proposed for construction. These are shown on the management maps to scale of 1 inch to 1 mile prepared for each range, and are described in the following paragraphs. Proposals are already afoot for the construction of certain of these roads by panchayat boards. If such proposals are put into execution in advance of forest requirements so much the better but as they will be intended to serve only occasional country traffic, they will probably fail to withstanding prolonged timber traffic. Reconditioning and upkeep will doubtless be jointly arranged between the Forest Department and the local bodies concerned. The District Forest Officer must satisfy himself on these matters in ample time for the preparation of estimates.

621. No road alignments have been accurately traced or surveyed by the working plans staff, but in the majority of cases no difficulty in aligning the traces is anticipated. Detailed estimates with surveyed road traces should be prepared three years in advance of the commencement of fellings in the respective coupes.

622. The following approach roads will be required for the transport of timber from coupes :—

Kasaragod Range.

623. An improvement to the entire cart track to Kilar from the sixty-fifth mile on the Mangalore-Mercara road for a distance of 2 furlongs, and a widening of the footpath to

Bantwadi which separates Sampaje coupes Nos. I and II ; total length about 4 furlongs. This will be required for extraction from Sampaje coupes I and II and will cost about Rs. 500.

624. A road from Aranthodu to Choripane enclosure, thence to Kanalethodu block in Sampaje reserved forest (coupes V to X, Kasaragod Felling Series) ; total distance 3 miles. This is already proposed for construction by the President of the Panchayat Board, as far as Choripane, but the precise date of construction cannot be ascertained at the time of writing. The road must be examined and reported on, together with estimate of costs of necessary works thereon, three years before the year in which coupe No. V will be felled. The probable cost for construction of the entire road (in case proposals by the Panchayat Board lapse) will be about Rs. 4,500.

Puttur Range.

624-A. An approach to coupe No. V (felling series ' A ') from the main coupe road which joins Baradka to the Jalsur Subrahmanyam Local Fund road ; total length 7 furlongs ; probable cost Rs. 1,000.

625. Improvements to the existing road to Polangayam, and widening of the present bridle-path from Polangayam to Kanthukumari (about 1 mile) ; to open coupes I to V, felling series ' B ' ; total distance 5 miles ; estimated cost Rs. 2,500.

B.—Buildings.

626. A range office at Kasaragod is urgently needed. The present office is in a rented upper storey in the main bazaar, and is unsatisfactory. Land has been reserved for the construction of an office behind the railway station at Kasaragod. In the event of funds being unavailable for the construction of this office in the next few years, the management will have to decide between the alternatives of constructing a temporary building on the reserved site at Kasaragod and of shifting the range headquarters temporarily to the old buildings at Adur. Either of these expedients should however be definitely temporary measures. Kasaragod should if possible remain the headquarters of this range, efforts being continued to rent, or dispose of, the Adur buildings. The cost of building a new permanent office will be about Rs. 2,500.

627. Government quarters for the Range Officer, Kasaragod, should be provided at the earliest opportunity. This building should be constructed close to the site of the permanent office. The estimated cost is Rs. 4,000.

628. Fresh quarters, with wells to house the subordinate staff in charge of Panathady, Painikere and Mukkudu beats in Kasargod Range are necessary and are prescribed for construction in 1932–33. It should be seen that the positions chosen possess reasonable amenities for the beat guards and their families in the purchase of commodities, etc., so that no difficulty will be experienced in getting the buildings occupied. The cost of these additional buildings will be about Rs. 1,800.

629. A double forest guards' shed is required at Jalsur for the beat guards of Anegundi and Kanakamajulu. The anticipated cost is Rs. 1,000. This is prescribed for construction in 1932–33.

630. A new forest rest-house for the accommodation of inspecting officers is desirable at Aranthodu (Sampaje) in Kasaragod Range. This may be postponed for a few years if the existing Local Fund rest-house at Sampaje is put in order. The District Board should be urgently approached and pressed to improve the present very inadequate accommodation in this matter. Construction of the forest rest-house should be timed at latest to coincide with timber operations in the neighbourhood of Choripane, so as to be available for the convenient supervision of these coupes near Choripane, when this block is opened up. This will be in the fifth year of the resumption of extraction from reserved forest, after the exploitation of unreserves is completed. The total cost of this contruction is estimated to be about Rs. 3,000 of which however only a portion (say Rs. 1,000) will be expended during the period of the plan.

631. A forest guards' shed should be constructed as early as funds will allow for the better protection and supervision of contemplated works at Devachalla. The cost will be about Rs. 600.

632. Improvements to the present ' Kachcha ' inspection shed at Polangayam are necessary. An outside kitchen and bath-room is required. The cost will be about Rs. 300. Before timber operations are undertaken, an additional building probably at Kanthukumari enclosure will be required for the Range Officer. Sheds will also be required to accommodate sawyers and coolies at Kanthukumari.

633. Forest rest-houses are required in the neighbourhoods of Panja (Puttur Range) and Dharmastala (Uppinangady Range). Neither of these are of immediate urgency, however, and both the actual location and the date of construction are left to the discretion of the District Forest Officer in consultation with the Conservator. Owing to the postponement in working of reserves for a period of about five years, it is probable that construction of these buildings will not be considered until revision of the plan in 1940.

634. Existing buildings and wells will be maintained in a proper state of repair and will be budgeted for annually by the District Forest Officer. A sum of Rs. 10,000 for repairs to buildings, and of Rs. 1,300 for repairs to wells, have been included in the financial estimate for the next 10-year period. The amounts are based on averages of past expenditure.

Stores, Tools and Plant.

635. Annual expenditure, both capital and ordinary, will be incurred in the purchase and repairs of elephant harness, tools, furniture, etc. Based on past actuals, the sum of Rs. 15,000 is allotted in the financial forecast for the period.

Fire Protection.

636. The reserves of this division are exceptionally vulnerable to fire, owing to the length of boundary which has to be maintained, and the danger to the forest occasioned every year by the burning of adjoining kumaki lands by property-owners. In 1930, the total length of reserve boundary was 1,236 miles. Of this total, about 400 miles are actually fire-traced, but the figure given probably includes some interior traces. The cost of fire-protection works out at between Rs. 4 and Rs. 5 per mile of fire trace, but has recently been reduced to Rs. 3 per mile. It is thought probable that under the prescriptions now proposed the total length of fire trace will be not far short of 550 miles.

637. Attempt to protect the entire forest property is impracticable at present, and would cost far too much. It is accordingly proposed to protect only certain portions of the forest, namely, those which are the most important, and those which are the most vulnerable. But much may be done to prevent firing, and to enlist the co-operation of the people, if burnt areas are closed to grazing, to allow of recuperation, and it is prescribed that this be done immediately and for such period as circumstances may direct.

638. Two facts are of importance. The first is the tendency of all forests, when adequately protected for a number of years to develop a large measure of self-immunity thereafter owing to the growth of an evergreen groundflora which will resist a casual flame even in the driest season. A second fact of importance in fire-protection is the existence of certain "danger spots" in the forest which owing to past burnings and misuse suffer a chronic susceptibility to fire, which accordingly tends year by year to encroach farther into adjoining forest. Short of protecting the entire forest, which is impossible, the best alternative is to protect a fraction only until it is more or less self-protective and to attempt to limit the spread of fires from "danger spots" wherever they might occur. The location of these danger spots is possible from the fire control maps, which at present are maintained only for a few reserves and for only very recent years in the majority of cases. Protective measures must therefore be gradual and progressive, accompanied by more thorough record and analysis of fire occurrences.

639. Subject to financial limitations (which may in the immediate future restrict policy to something less than that thought fully adequate) the measures prescribed below shall be carried out, in the order of importance given. Where fire-tracing is prescribed, the mode of precedure will be to cut guide lines 5 feet wide and to burn the intervening strip; but where the trace runs along an exterior boundary only one guide-line on the interior side will be necessary. Where the forest abuts on to a perennial stream no trace will be burnt.

640. The following measures are prescribed :—

I.—Areas under regeneration.

641. (*a*) Plantations under shelterwood will receive further protection for ten years. Their perimeters will be fire traced on all vulnerable sides to a width of 20 feet on exterior lines and for 10 feet where they adjoin a similar plantation. Fire patrols will be appointed during the dry season in Parappa, Porkala, Padnur and Mundaje-Kap. The Parappa patrol will also watch the Hopea plantations in Mandekole reserve.

(*b*) All coupes under regeneration, including those which have been formed since 1925 will be separately fire traced to a width of 20 feet where they adjoin natural forest and for 10 feet where they adjoin other coupes.

(*c*) Blocks included in the present regeneration area of the Timber Working Circle, whether actually under regeneration or not will be fire traced to a width of 20 feet along those portions which adjoin public roads and enclosures, or are in any way vulnerable to fire.

(*d*) Fuel coupes will be fire traced around the full periphery of the block or reserve (except where they are bounded by streams). The boundary of each annual coupe, as also the margins of any extraction road which may be in actual use, will be scraped and burnt in the year following felling to a width of 10 feet, but not subsequently.

(*e*) Sandal propagation centres will be protected in the manner prescribed in paragraph 605 for a period of three years.

II.—Exterior and Interior Boundaries.

642. (*a*) Road margins shall be fire traced on both sides to a width of 15 feet except in the following instances :—

(i) where the road passes through a cutting at least 10 feet deep ;

(ii) where the forest descends into a mullah or stream running parallel to and only a short distance from the road ;

(iii) where the character of the vegetation bordering the road is distinctly evergreen or sub-evergreen for a distance of at least one furlong into the forest and holds no evergreen trees of value.

(iv) any other reason which the Range Officer may consider wholly adequate to eliminate ordinary risks, such reasons being reported to the District Forest Officer.

(*b*) All rights-of-way, frequented footpaths, bridle-tracks, but not inspection paths unless they are used by coolies, shall be fire traced. Exception may be made if such paths lead through heavy evergreen undergrowth, and there are no evidences of fire having occurred in the vicinity for a number of years.

III.—Areas particularly vulnerable to fire.

643. The first essential is the correct posting and maintenance of fire-control records and maps. During inspections, range officers should satisfy themselves that all fire-occurrences are reported by beat subordinates. This at present is often far from being the case.

Areas adjoining pattas and kumakies which are apt to suffer yearly from fire will be inspected by the Range Officer and the circumstances reported to the District Forest Officer. Measures will be taken, either by fire-tracing exterior boundaries and interior foot-paths to a width of 20 feet or alternatively by early burning the affected areas, to reduce the extent of the occurrences. Early burning will be tried first in areas where the undergrowth is mainly thatch ; where there is a reasonable chance that undergrowth of a thick-leaved evergreen type can be induced to appear by careful protection, or as in foothill reserves where the correct season for early burning is uncertain and a burn difficult, fire-tracing is preferable.

The following reserves require special protection of the above nature, viz., Mandekole, Adur, Balpa, Kadambilla, Shibaje, Devachalla and Dharmastala-Mundaje. As a tentative measure, fire watchers should be employed in these reserves in order to locate fires (which are thought to be often wilfully caused) and to trace offenders. If necessary punitive measures against offending communities should be enforced with greater rigour than has hitherto been the case.

IV.—Ghat Areas.

644. Grassy patches, especially adjoining footpaths which lead to the Mysore and Coorg boundaries, shall be early burnt each year.

645. The District boundary shall be cleared to the full width of 10 feet on the Kanara side along those portions ordered by the District Forest Officer each year. So far as is known, escapes from above ghats into Kanara territory are rare, and will be minimized by early-burning of grassy slopes used for grazing purposes.

UNREGULATED FELLINGS AND REMOVALS ON SEIGNIORAGE.

646. The present system of timber transit is reported to be working satisfactorily and will be continued. Continued vigilance against theft will be necessary in Kasaragod Range, and particularly along the Paiswani river-banks and in the Nileshwar-Panatady section.

ENJOYMENT OF CONCESSIONS.

647. Cases of abuse of the special concessions for South Kanara wherever observed, should be carefully noted and reported to the Conservator from time to time with the object of punitive cancellation permanently or for a given period, in order to put a stop to such abuses. Dharmastala, Dadanthamale, Anegundi, Mandekole and Balpa blocks appear to be particularly open to such abuses. After repeated requests, the Government have in their Order No. 2765/1-32-1, dated 5th December 1932, agreed to the principle and have ordered that, to start with, from 1933-34, Veeracumba Reserved Forest shall be closed to the concessions.

RECTIFICATION OF BOUNDARIES.

648. Present Section 16 Notifications are vague, and the data are rarely plottable (vide paragraph 29 of Part I). Resurvey of the boundaries of all forest blocks except those already resurveyed in Kasaragod Range since 1925 is desirable. Boundaries should be verified, and revised descriptions published in lieu of the present unsatisfactory ones wherever necessary. Perambulation by a small special forest staff will be necessary. Modifications of the present complex boundaries are possible in certain instances, as for instance, in the elimination of long extrusive tongues of forest reserve where they appear to have small protective or timber value and in the reservation of unoccupied Government waste-land containing valuable forest growth closely adjoining reserved forest.

LIVESTOCK.

649. *Elephants.*—An analysis of past working shows that an average daily haul by an elephant amounts to 108 cubic feet. During the year the average number of working days is 200. This amounts to a total haul of 21,600 cubic feet per elephant during the year. The present number of elephants in the division is seven. This appears excessive for the purpose of dragging our future requirements of logs, but the disposition of dragging elephants required to drag timber from unreserves to convenient carting depots during the next few years cannot at the time of writing be foreseen. The work will probably be more diffuse than is usually the case when dealing with single coupes in reserves and the existing establishment may, in consequence be, fully employed. A statement giving the cost of maintenance and of dragging is given in paragraph 122.

Provided suitable grazing grounds are sought out, with ample fodder and water, there should be little sickness in South Kanara. Elephants should be given at least two months' rest during the hot weather. Dragging should be commenced early in the day and work during the heat should be minimized.

650. *Buffaloes.*—The use of buffaloes for dragging having been discontinued, their future employment is not anticipated.

651. *Capture of elephants.*—Elephant capturing operations should be resumed in the division as early as convenient after sales again become profitable. No operations have been conducted in the division since 1921 and herds cause considerable damage to agriculturists under the ghats. Sampaje, Kilarmale and Shirady localities are suggested as suitable for pitfalls, the first-named having prior urgency.

EXPLOITATION AND UTILIZATION.

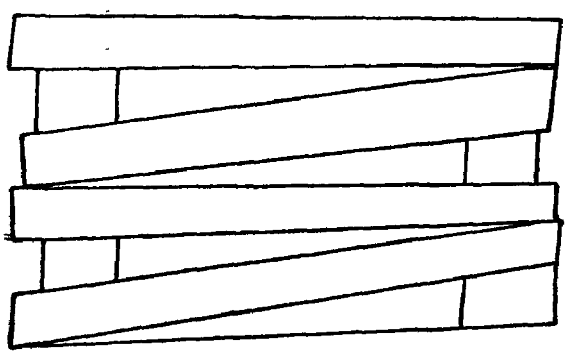
652. The development of sleeper sawing at stump-site in the forest is dvocated. The use of dragging elephants on the steep slopes of evergreen forest, as for example, on Bantamale ridge, will not always be possible. Sawyers will need some urging to accommodate themselves to this system, especially in leech-infected jungles, and it is advisable to get them accustomed to doing so in advance of actual necessity. The use of slides for transport of material to lower contours may be feasible, but hand-transport of sleepers will have to be arranged for in certain coupes.

653. In the Silent Valley, two coolies are required to handle a B.G. and one coolie a M.G. sleeper. (A single Kanara coolie may not be able to manage a M.G. sleeper unaided.) Coolies start work about 7–30 a.m., and finish at the foot of the hill at about 4 p.m. They demand Re. 1 per man or Rs. 2 per B.G. sleeper, the total distance carried and dragged being about five miles, including three miles on the plateau, this being considered the maximum they can do. No relays are used. In Kanara, the maximum economic dragging and carrying distance will be less, owing to the inferior stamina of the average coolie. This can be overcome to some extent by arranging for the coolies to live in lines close to the work, so that a minimum of time and energy is lost in getting to the work. Labour in this division is normally inclined to start work at 8 a.m. or even later. Heavy work of this nature should, however, as far as possible be achieved before the heat of the day, and in order to secure maximum efficiency, it will be necessary to marshal coolies at the felling site not later than 7-30 a.m.

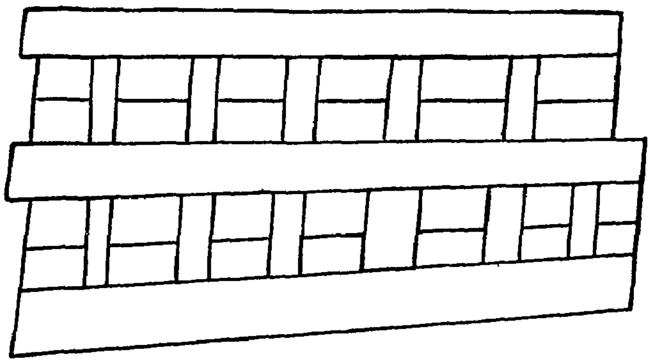
654. Until a creosoting plant for sleepers is available on the West Coast, or some other market is found for species such as *Dichopsis elliptica*, *Dipterocarpus*, *Eugenia gardneri*, etc., it is unlikely that the evergreen forests can be exploited except for the extraction of Hopea and *Mesua* which are suitable for use as sleepers without previous impregnation, and of high grade construction timber such as *Artocarpus hirsuta*. Endeavours should be made to popularize *Dichopsis elliptica* and other common species in the local markets. This should not be difficult as a regular demand for hand-sawn sizes of these softer woods has been created in other districts, such as Palghat, Malabar and Tinnevelly, and there would seem to be no reason why similar success should not attend organized endeavour in South Kanara also. No experience has yet been gained in the sawing and conversion of *Mesua ferrea* in South Kanara, and before coupes containing an appreciable quantity

of this species are extensively opened up it is advisable to test the soundness of this timber by trial conversion. A higher rate for sawing is probably inevitable ; this fact combined with the somewhat inaccessible and difficult nature of the localities to be exploited point to the advisability of ascertaining costs of extraction before final estimates are submitted. Such coupes will not be worked during the next ten years.

655. The necessity for the proper stacking and seasoning of sleepers and other sawn produce, both in the forest and at depots, has already been alluded to (para. 344). The system advocated by the Forest Utilization Officer is now in use in the division, and should be adopted at all forest depots in future. The espacement between sleepers depends on the weather and locality. Where a hot dry wind will blow, sleepers should be placed about one inch apart. The cooler it gets, the wider can be the espacements, up to about three inches. The percentage of sleepers passed at coastal depots is gradually being improved, especially in the case of *Xylia xylocarpa* during the past year. This is achieved by more careful passing in the forest, and by rapid transport and final passing at depots before delivery. The converse process, of retaining *Xylia* sleepers under proper cover carefully stacked, in forest depots, for a period of at least six months subsequent to conversion, is also prescribed for trial. Ten per cent of the sleepers of all species extracted should be treated in this way and results compared, for the first three years of extraction under this working plan. Future practice will depend on the result of this experiment. Green conversion of all species is desirable. A diagram showing the correct method of stacking sleepers is provided below :—



SIDE



END

656. The possible necessity for differential treatment of sleepers cut from large size logs of *Xylia* in order to secure the best results should also be borne in mind. As an experiment, sleepers cut from logs of 4 to 5 feet girth should be stacked separately from those cut out of larger logs, and piles, say 50 of each group, retained in the forest for seven months, for comparison as to the respective degree of splitting obtained, and as to the percentage of sleepers finally passed from each group. At least six inches (three inches at either end) should be left on the sleepers in order to take up early end-cracking in all cases. These will be cut off at coastal depots before final passing. Inclusion of the heart (or pith) should be avoided as far as possible ; 50 per cent of rejections of *Xylia* are due to " boxed heart "; theoretically the heart should be at least two inches outside the sleeper altogether, but a sound sleeper, even though it has boxed heart is at present acceptable. Generally however sleepers which have boxed heart are subject to close scrutiny before passing, owing to the tendency for shakes to develop from the heart ; where a defect comes through on both sides it is liable to rejection.

657. In the case of sapwood appearing in a sleeper, a wise rule to follow when passing at jungle depots is that when the heart-face of the sleepers is laid downwards on the ground, sapwood at the upper corners should not extend more than two inches measured along the diagonals.

658. The following is an extract of the Proceedings of the Fifth Annual meeting of the Sleeper Pool Committee :—

" Broad gauge (B.G.) sleepers shall measure not less than 9 feet long, 10 inches wide and 5 inches thick. Metre gauge (M.G.) sleepers shall measure not less than 6 feet long, 8 inches wide and 4½ inches thick.

The sleepers shall be sawn from sound logs of the species mentioned above. They shall be straight and out of winding and with faces square to one another. The wood in the sleeper shall be free from sapwood, heart-shakes, serious cracks, split ends and large knots, and free from anything near the rail seat which might interfere with the driving or screwing of spikes."

The above dimensions are now insisted upon and any sleeper below these dimensions is liable to be rejected. Sawing undersize is an extremely common fault of the sawyers.

Bamboo Sales.

659. Owing to comparatively recent flowering of bamboos throughout the division no regular working of bamboos is prescribed during the forthcoming period. The distribution of the present young crop is still uncertain and the clumps are immature. It will be open to the District Forest Officer to approve the sale and disposal of mature or dead bamboo either by coupes or separately, as demand arises.

Grazing.

660. The total area available for grazing after excluding 'inaccessible' portions is about 128,000 acres. The grazing incidence within reserved forest is very light, amounting to 5·9 acres per cow-unit on the so-called 'accessible' forests. The present rates for grazing leases, viz., 10 annas per head of buffalo and 6 annas per cow will be maintained. The area which will be closed to grazing during the working plan period is about 7,500 acres in all.

Recommendations of the Royal Agricultural Commission.

661. *Grass-cutting.*—There is an abundance of grass throughout the kumakies, unreserved and waste lands of the division. Within reserves it is freely resorted to in the more closely wooded tracts.

Fodder.—Fodder supply from reserves is already permitted and freely availed of by ryots under the special concessions for South Kanara.

Shifting cultivation.—The practice of 'kumri' is now effectively under control in South Kanara, and within reserved forest, controlled clearings will be permitted under departmental supervision on a small experimental scale during the period of this plan (vide paragraphs 516–521).

Village panchayats.—This system, applied to certain reserves, has already been tried (vide paragraph 52); it has not proved a success and the villagers are lukewarm in any desire to avail themselves of the grazing concessions offered in return for efficient protection of reserves in their village.

Research and Collection of Statistics.

662. (*a*) *Volume tables.*—A start has been made in the preparation of volume tables during the preparation of this plan. Curves drawn and data collected will be filed in the office of the III Circle as well as in that of the Provincial Sylviculturist, both at Ootacamund. The data utilized in this working plan are however really inadequate for results to be reliable over the whole range of girth-classes, while quality classes have not been considered at present. For future information, the breast-height girths of all trees felled must be accurately measured and recorded in the marking registers, and communicated to the Provincial Sylviculturist, for his use in the preparation of final tables when the data is sufficient for accuracy.

663. (*b*) Information regarding the ages corresponding to girths and heights of trees is lacking in this division. This will be progressively obtained, only from plantations of known age when they reach a suitable age. At present they are too young. Sample plots will be laid out when plantations have reached an age of ten years. The District Forest Officer should consult the Provincial Sylviculturist regarding the subsequent selection of trees for stem analysis.

664. (*c*) Opportunity for the collection of experimental data is afforded in the clear-felling experimental working circle, but this will refer only to the early stages of regeneration in clear-felled areas. The Provincial Sylviculturist should be consulted freely on matters of difficulty, and acquainted with any circumstances which appear worthy of record.

665. (*d*) *Sample plots.*—The measurements hitherto recorded from sample plots of *Hopea parviflora* under shelterwood have been plotted and filed in the III Circle office as well as in the Office of the Provincial Sylviculturist. The general results showing height-growth up to the present year are recorded in Part I (Chapter VI) of this plan.

The number of plots at present maintained for Hopea is thought to be in excess of requirements, while their condition leaves considerable room for improvement. Fewer plots better kept would be more satisfactory. No plots are now under the direct control of the Provincial Sylviculturist. Research on scientific lines cannot properly be left to the territorial staff, although normal upkeep and maintenance of the plots might be conducted by them under suitable guidance. Certain plots are of sufficient importance for continued record, these being our oldest and most reliable sources of information on this species.

But boundaries are sometimes ill-defined, the degree of shade cast by the upper canopy is irregular, and the same measure of sylvicultural attention as that given to surrounding forest does not appear invariably to have been given to the sample plots. Old stakes have fallen down and require renewal. Entirely fresh and up-to-date instructions in the methods of upkeep and measurement ought to be issued, and it would be preferable for one person to be responsible for this work, rather than that it be left in the hands of section foresters. If possible, an early visit by the Provincial Sylviculturist should be arranged, so that he may inspect the plots in Parappa, Porkala-Padnur and Mundaje-Kap and give suitable instructions for their future maintenance. Occasional future visits not necessarily yearly, but at regular intervals would also be advisable.

Although the successful raising of *Hopea parviflora* may be regarded as having passed beyond the experimental stage, there is still nevertheless a wide field for research in the regeneration of other species in South Kanara in particular in respect of teak, *Artocarpus hirsuta* and *Mesua ferrea*. This district is much behind other important timber-bearing districts in this respect. It also offers an interesting field for ecological research.

Entomology.

666. Further investigation is required in the isolation of insects which cause damage to tender twigs and shoots of young Hopea and *Artocarpus hirsuta*, and in the measures necessary for their control. These insects cause up to 100 per cent loss in height-growth during the early years of Hopea.

In the older woods, attacks by stem-borers in *Hopea parviflora* require investigation on the following points :—

(i) the times of emergence of the beetle so that steps for its control might be taken ;
(ii) the incidence of attacks in the neighbourhood of recently felled areas, especially having regard to the importance of old stumps as breeding centres of infections ;
(iii) increase in the attacks made on mature or healthy stems in the neighbourhood of fire-scorched areas ;
(iv) evidence of attacks on healthy stems, whether sporadic or endemic to certain localities ;
(v) estimate of financial loss due to borer attacks.

The District Forest Officer should make such notes as he is able to on these points, in the Control Journal ; and when some reliable preliminary information has been thus collected, the advisability of asking for the assistance of the Central Forest Entomologist from the Forest Research Institute at Dehra Dun should be considered ; and in the meanwhile, all the information collected should be communicated to him.

Control.

667. The District Forest Officer is personally responsible for the correct posting of control records. The first period of this plan is largely an experimental one. The present lack of exact data, and the scanty records that have been compiled in the past are partly responsible for the vagueness of our present knowledge regarding these forests. The importance of accurate control, especially during early years is therefore emphasized.

668. For the miscellaneous prescriptions given under this chapter the control records are as follows :—

The Record of Works and Fire Control Maps.

CHAPTER XI.—ESTABLISHMENT AND LABOUR.

Section 1.—Establishment.

669. *Executive staff.*—The protective staff has always been inadequate for the proper surveillance of the forests. Kasaragod Range is by far the most vulnerable to illicit removals and to wilful incendiarism, due to the facilities offered by navigable rivers for the rapid transport of produce to the coast and the comparative paucity of timbered areas outside the reserves. The population south of Kasaragod and in the neighbourhood of newly notified reserves are not educated in forest laws, this tract having been neglected during former settlements. The other ranges contain some very large beats which cannot be effectively protected, yet their nearer proximity to the ghats and the smaller density of the population inland gives them a greater measure of immunity from illicit exploitation than those in Kasaragod Range. In the present plan, therefore, additions to the protective staff are proposed only for the last-named range. The following changes are proposed :—

670. (i) *Adur beat.*—This is a former kumri-village tract, and contains many enclosures. Owing to the proposed kumri-fellings under departmental supervision, one beat-guard cannot effectively protect this reserve, and a watcher is necessary for his assistance.

671. (ii) *Mandekole beat.*—This is also a former kumri village. Mandekole is an important reserve on account of its favourable position for river transport, and it is too large for one beat-guard unaided. A watcher is necessary in order to locate fires, to prevent illicit removals of timber, lopping of trees and other abuses.

672. (iii) *Aletti beat.*—This contains both Aletti East and Aletti West blocks, the combined extent of which is too much for one guard. Aletti East, with its extension should be formed into a separate beat.

673. (iv) *Bantaje and Kannadka beat.*—An additional watcher is required to assist the beat-guard.

674. *Staff for works.*—For the works of timber extraction, regeneration and sylvicultural operations prescribed in the plan, one special duty Ranger is necessary in the division. The abolition of the Beltangady Range makes available one Ranger for special duties and no increase of the staff of rangers is expected to be necessary. The continued attachment of a junior gazetted officer is essential. For additional special duties, e.g., boundary rectification, road construction, etc., the District Forest Officer will submit proposals as necessity arises.

675. *Clerical establishment.*—No changes are proposed.

Section 2.—Labour.

676. The labour shortage will continue acute in regeneration centres during the rains and at harvesting seasons. At other times little difficulty in obtaining unskilled labour is anticipated. Sawyers will have to be recruited as hitherto from Malabar. Special arrangement for housing coolies will have to be made for the Sampaje and Bantamale coupes. The forests around Sampaje have an ill name in the district on account of malaria, and every endeavour must be made to minimize sickness among the labour force by careful selection of housing sites, and by the free distribution of quinine either from the local dispensary or by the Range Officer. Payments in kind during the wet season will be arranged as necessary. It is not unlikely that coolies will demand extra rates in order to come and live in these out-of-the-way places ; this, if unavoidable, might best be paid in grain and other commodities. No reliance can at present be placed on forest settlements in the ghat localities, since little disposition has hitherto been evinced to take up disreserved land on darkhast. It remains to be seen whether useful coolies can be attracted by the system of kumri working in reserved forest.

CHAPTER XII.—FINANCIAL FORECAST AND COST OF THE PLAN.

Section 1.—Financial Forecast.

677. Not inconsiderable difficulty is felt in presenting a forecast of the financial results of this plan. It is usual to give a balance account showing the anticipated total revenue and expenditure for the area covered by the working plan for the period during which it is applied, generally for ten years. The circumstances in which this plan is formulated and will take effect are exceptional. For a preliminary period of six years, more or less, the plan will cover only a part of the work of the division, since the major works of timber extraction will lie in unreserved lands of which this plan takes no cognizance (vide paragraphs 301, 306 and 307). The plan will therefore cover the entire division only when timber extraction and regeneration operations are resumed in reserved forest, and works relinquished elsewhere. Judging from the preliminary report (with District Forest Officer's reference C. No. 101/31-A, dated 30th July 1931 to Conservator, VI Circle), on the potentialities of Government unreserved and waste lands, 'kumakis', 'kanes' and 'banes' in South Mangalore Division, it has been tentatively assumed that the working plan for the Timber Working Circle (Chapter II) will begin to take effect in 1937–38. The prescriptions for other working circles will take effect immediately. It is thought inadvisable in the present circumstances to embody rough preliminary estimates on the financial results of 'unreserve' working (for which this plan is not responsible) but which nevertheless amount to several lakhs of rupees, in a statement embodying other items calculated to some nicety. The financial statement is therefore shown in two parts, viz., (i) an unbalanced and incomplete statement, showing the items of expenditure and revenue anticipated solely under the provisions of this plan for the conjectured period during which timber is extracted from unreserves, i.e., from 1932–33 to 1936–37 ; and (ii) a balance statement showing the results of working under the prescriptions of this plan in its entirety for the remaining four years 1937–38 to 1940–41.

678. Further perplexity arises with any attempt to anticipate future prices and costs on the criteria of the very fluctuating rates which have characterized recent years. The slump in timber prices, which began to be felt seriously in 1930–31 greatly affects the quantity and quality of the material which can be extracted from remote sites such as the present coupes, which even in normal times can be worked with only a small margin of profit

A fall of 4 or 5 annas in the price per cubic foot of log, such as is now experienced, at once eliminates from consideration the extraction of any but the most superior species in the forest. The duration of the present period of economic depression cannot be well foreseen, but it might reasonably be assumed that a recovery is due before the close of the decade, and with it a rise in the cost of living. Yet it is not easy to justify the adoption of correspondingly higher sale prices of timber and other produce to the pitch reached during the flourishing years of the past decade. Estimates of the cost of production of produce are not therefore calculated on the present reduced rates now in operation (vide paragraph 122). Estimates of timber prices are however pitched rather low, in consideration of recent past averages, although it is expected that markets will improve gradually. Much depends upon the supply, as well as upon the demand, which latter may be assumed to remain normal throughout. Recent years have witnessed the extraction of quantities in the region of two lakhs of cubic feet of timber annually, much of which was sawn, in the expectation based upon American experience, of creating by degrees a large local retail market. This has not materialized, with the result that heavy quantities have remained over in depots undisposed of both of logs and sawn grades. This has served only further to precipitate the abasement of sale prices.

679. The working plan when in full working contemplates the extraction of no more than about 75,000 cubic feet of timber annually the majority of which will be converted into railway sleepers at fixed rates of sale. An advantage derived from working the unreserves in the meanwhile is that quantities should be easily adjustable to the requirements of local markets, as indicated by prices offered, so that no large stocks remain in the depots. It is moreover entirely probable that by depleting the resources of timber outside Government reserves, the demand for timber coming from reserves will be considerably enhanced hereafter.

680. Expenditure in the past ten years has also been exceptionally heavy on works of regeneration. As much as 700 to 800 acres annually have been first regenerated and have then required detailed subsequent attention. The extent of regeneration contemplated for the future, while more than adequate to replace the timber extracted, is no more than one-fifth or one-sixth of the extent formerly undertaken.

681. The functions of forest protection, which are of such paramount importance to the well-being of Kanara, depending as it does upon natural irrigation and perennial springs for agriculture all the year round, have necessitated a large protective establishment which is irreducible, as well as other expenditure not remunerative in terms of direct revenue to the department. This constitutes a heavy burden on the district budget.

682. The result of the above circumstances has been a revenue deficit in the annual financial returns of the division for six years out of the past ten, and an average annual deficit of Rs. 23,000 for the past five years in succession. This is not easily remedied by any measures which can be prescribed, the more especially as accessible localities of reserved forest (whence timber might be cheaply extracted) are immature or already worked out. All other sources of revenue are necessarily based on past averages.

683. On the expenditure side, certain charges are rightly borne which are not shown in the annual Administration Reports, such as 'Interest on capital expenditure' and 'Direction charges.' In the case of buildings constructed in the past, these are considered as having been paid for out of revenue. Similarly, certain extraction roads altogether within the limits of timber or fuel coupes, as for example, the road in Parappa reserve constructed for the purpose of supplying logs to the sawmill, and the extraction roads in Compartment 1 of Nalkur reserve, are considered as having been entirely paid for out of revenue obtained from the specific produce of these coupes. On the other hand, the Muroor-Kolchar road in Kasaragod Range, which serves the purpose of general development of the district as well as having been necessary for the extraction of timber from Aletti West and East coupes, has been only part debited (one-third) against past timber works, the balance being considered as capital on which interest is charged. Upon all new capital expenditure incurred during the period of the plan, interest at 5 per cent per annum is calculated. Under 'Direction charges' the proportionate cost of Conservator, VI Circle, is estimated with due regard for the direct attention which the division gets. There are six divisions in the circle, but in consideration of the fact that the division as a rule is visited but once a year by the Conservator, whereas Nilambur, the Nilgiris, Wynaad and Palghat Divisions are more fortunate, one-fifth the cost of Direction is charged to the whole of South Kanara, and therefore one-tenth only is allotted against South Mangalore Division.

684. The cost of establishment has been slightly reduced by the abolition of one range charge, but the protective establishment has been slightly increased (vide paragraphs 669 to 674).

685. The revenue surplus shown for the working plan period is negligible, but must be considered in relation to past deficits. Total revenue for the division amounts to the equivalent of 2 annas 2 pies per acre of the entire area of reserved forest, although approximately one-third of the gross revenue is derived from Government unreserved lands, and not from reserves. Expenditure amounts to practically the same sum. These figures are remarkably small compared with similar figures per acre for Mount Stuart and Nilambur Divisions, and serves to show how large a proportion of forest property is of no value save as protection of hill-slopes against erosion. No immediate improvement in the financial position can be looked for until the markets for timber, fuel and minor products appreciate so as to absorb the produce of these forests at prices more remunerative than can be hoped for in the immediate future.

I.—*Financial forecast for the period* 1932–37.

686. Revenue—

Particulars.	Amount.
	RS.
1 Clear-felling Working Circle—	
By sale of 30,000 c.ft. of logs at 15 annas per cubic foot.	28,125
By sale of 1,110 broad gauge sleepers at Rs. 7–12–0 per sleeper	8,600
By sale of 1,350 metre gauge sleepers at Rs. 3–2–0 per sleeper	4,220
By sale of 1,800 c.ft. of scantlings at Re. 1–1–0 per cubic foot	1,910
2 Fuel Working Circle—	
By sale of fuel coupes—	
Muliar-Karadka Felling Series, 360 acres at Rs. 15 per acre	5,400
Narimogar Felling Series, 126 acres at Rs. 20 per acre	2,520
Nerankimale Felling Series, 140 acres at Rs. 30 per acre	4,200
3. Sandal Working Circle—	
By sale of 25 tons at Rs. 1,200 per ton	30,000
4 Minor Produce Working Circle—	
By lease of farms for six years at Rs. 7,780 per annum	46,680
5 Grazing—	
By sale of grazing permits at Rs. 9,000 per annum	54,000
6 Miscellaneous—	
(*a*) Timber from unreserves being the tree value on lands assigned on patta by the Revenue Department at Rs. 8,000 per annum (based on past actuals)	48,000
(*b*) Fuel from unreserves being the tree value on lands assigned on patta by the Revenue Department at Rs. 800 per annum (based on past actuals)	4,800
(*c*) Sale of elephants	Nil
(*d*) Compounding fees, water diversion, rent on buildings, etc., at Rs. 11,000 per annum (based on past actuals)	66,000
Total	3,04,455

687. *Expenditure*—

1 Timber Working Circle—	
Tending natural regeneration on already felled coupes of Kasaragod, Puttur A and B and Uppinangady series—1,270 acres at Rs. 2–8–0 per acre	3,175
2 Clear-felling Working Circle—	
Production of 30,000 c.ft. of logs at 11 annas per cubic foot	20,625
Production of 1,110 board gauge sleepers at Rs. 3–14–0 per sleeper	4,300
Production of 1,350 metre gauge sleepers at Rs. 1–15–0 per sleeper	2,620
Production of 1,800 c.ft. of scantlings at Re. 1 per cubic foot	1,800
Formation of 100 acres (departmentally) at Rs. 30 per acre	3,000
Formation of 120 acres of kumri plantation at Rs. 12 per acre	1,440
Formation of 60 acres in Nerankimale at Rs. 22 per acre	1,320
Tending 280 acres at Rs. 10 per acre	2,800
3 Plantation Working Circle—	
Tending 4,000 acres of Hopea under shelterwood at Re. 1–4–0 per acre	5,000
Tending 108 acres of deciduous plantation at Rs. 1–8–0 per acre	160
Tending 190 acres of old kumri plantation at 12 annas per acre	140
4 Fuel Working Circle—	
Tending and regenerating in blanks, 626 acres at Rs. 4 per acre	2,500
5 Hopea Improvement Working Circle—	
Tending 2,200 acres at 8 annas per acre	1,100

Particulars.	Amount.
	RS.
6 Sandal Working Circle—	
Extraction, clearing and transport of 25 tons at Rs. 70 per ton	1,750
7 Items common to all working circles—	
Stores, tools and plant at Rs. 1,400 per annum	8,400
Elephant capturing operations	Nil
Capital—Old existing works—	
Murur-Kolchar road—two-thirds of its cost of construction, Rs. 7,000. Interest at 5 per cent for the period of six years	2,100
Maintenance of roads and bridges—	
Thirty miles of unmetalled road at Rs. 30 per mile per annum	5,400
Maintenance of buildings at Rs. 1,000 per annum	6,000
Maintenance of wells at Rs. 150 per annum	900
Fire protection—	
Protection of areas under regeneration included in estimates of costs of formation	Nil
Fire-tracing of road margins and footpaths and reserve boundaries, 550 miles at Rs. 3 per mile per annum	9,900
Early burning, pay of fire patrols in specially protected areas at Rs. 800 per annum	4,800
Establishment—	
Pay of District Office establishment—	
Pay of District Forest Officer at Rs. 750 per mensem	54,000
Pay of gazetted assistant at Rs. 375 per mensem	27,000
Pay of office establishment at Rs. 480 per mensem	34,560
Pay of one special duty Ranger at Rs. 100 per mensem	7,200
Pay of Range establishment—	
Kasaragod Range at Rs. 1,100 per month	79,200
Puttur Range at Rs. 590 per month	42,480
Uppinangady Range at Rs. 545 per month	39,240
Allowances—	
Travelling and other compensatory allowances at Rs. 10,000 per annum (past average Rs. 11,500 but this figure reduced owing to retrenchment).	60,000
Contingencies at Rs. 2,500 per annum (past average was Rs. 2,900, but this figure reduced owing to retrenchment)	15,000
Direction—	
Proportionate pay of the Conservator and his establishment Rs. 44,000 per annum. The Conservator spends about one-fifth of his touring in South Kanara every year. This is divided between the two divisions, North and South Mangalore. So one-tenth of Rs. 44,000 or Rs. 4,400 per annum for six years for this division	26,400
Total expenditure for the 6 year period	4,74,310

II.—*Financial forecast for the period* 1937–38 *to* 1940–41.

688. *Revenue*—

Particulars	RS.
1 Timber Working Circle—	
By sale of logs (vide paragraph 334)—	
11,120 c.ft. of teak at Rs. 1–8–0 per c.ft.	16,680
17,350 c.ft. of *Artocarpus hirsuta* at Rs. 1–10–0 per cubic foot	28,190
1,150 c.ft. of *Dalbergia latifolia* at Rs. 1–10–0 per cubic foot	1,870
76,164 c.ft. of *Terminalia tomentosa* of which 46,500 c.ft. will be saleable at 15 annas per cubic foot	43,590
21,445 c.ft. of *Lagerstroemia lancelata* of which 16,500 c.ft. will be saleable at Re. 1–1–0 per cubic foot	17,530
74,627 c.ft. of miscellaneous species—mostly *Terminalia paniculata*—but only 32,000 c.ft. of saleable grades at 14 annas per cubic foot	28,000
By sale of sleepers—	
19,200 broad gauge sleepers of *Hopea parviflora* and *Xylia xylocarpa* at Rs. 7–12–0 per sleeper	1,48,800
12,750 metre gauge sleepers of *Hopea parviflora* and *Xylia xylocarpa* at Rs. 3–2–0 per sleeper	39,840
3,260 rejected broad gauge sleepers at Rs. 1–8–0 per sleeper	4,890
2,179 rejected metre gauge sleepers at 12 annas per sleeper	1,630
By sale of scantlings—	
14,000 c.ft. of *Hopea parviflora* at Rs. 1–10–0 per cubic foot	22,750
8,000 c.ft. of *Xylia xylocarpa* at Re. 1 2–0 per cubic foot	9,000

Particulars.	Amount. RS.
2. Clear-felling Working Circle—	
By sale of 20,000 c.ft. (vide paragraph 470) of logs at 15 annas per cubic foot ..	18,750
By sale of 740 broad gauge sleepers of *Xylia xylocarpa* at Rs. 7–12–0 per sleeper	5,730
By sale of 900 metre gauge sleepers of *Xylia xylocarpa* at Rs. 3–2–0 per sleeper.	2,810
(Scantlings will not pay to market.)	
3 Fuel Working Circle—	
By sale of fuel coupes (vide paragraph 551)—	
Muliar-Karadka Felling Series, 250 acres at Rs. 15 per acre	3,750
Narimogar Felling Series, 90 acres at Rs. 20 per acre	1,800
Nerankimale Felling Series, 85 acres at Rs. 30 per acre	2,550
4 Sandal Working Circle—	
By sale of 15 tons of cleaned sandalwood at Rs. 1,500 per ton	22,500
5 Minor Forest Produce Working Circle—	
By lease of minor forest produce farms for four years at Rs. 7,780 per annum (based on the average of the past ten years)	31,120
6 Grazing—	
By sale of grazing permits at Rs. 9,000 per annum (based on the average of the last six years)	36,000
7 Miscellaneous—	
(*a*) Timber from unreserves, being the tree value on lands assigned on darkhast by the Revenue Department at Rs. 8,000 per annum (based on past actuals)	32,000
(*b*) Fuel from unreserves, being value of fuel on lands assigned on darkhast by the Revenue Department at Rs. 800 per annum (based on past actuals)	3,200
(*c*) By sale of elephants	9,000
(*d*) Compounding fees, water diversion leases, import duty on fuel brought to towns, rent on buildings, etc., at Rs. 11,000 per annum for four years (based on past actuals)	44,000
Total revenue for the 4-year period ..	5,75,980
Average annual revenue ..	1,44,000

689. *Expenditure*—

1 Timber Working Circle—	
(*a*) Kasaragod Felling Series—	
Production of 54,550 c.ft. of logs at As. 10–6 per cubic foot	35,800
Production of 4,300 broad gauge sleepers at Rs. 3–14–0 each (vide paragraph 122)	16,660
Production of 2,850 metre gauge sleepers at Rs. 1–14–0 each (vide paragraph 122)	5,340
Artificial regeneration of 60 acres at Rs. 40 per acre (vide paragraph 431)	2,400
Tending 20 acres of natural regeneration at Rs. 2–8–0 per acre ..	50
(*b*) Puttur Felling Series 'A'—	
Production of 24,100 c.ft. of logs at As. 12–9 per cubic foot	19,200
Production of 7,680 broad gauge sleepers at Rs. 4–4–6 each	32,880
Production of 5,100 metre gauge sleepers at Rs. 2–1–0 each	10,520
Production of 9,000 c.ft. of scantlings at Rs. 1–3–6 per cubic foot (vide paragraph 122)	10,970
Artificial regeneration of 90 acres at Rs. 7–8–0 per acre (vide paragraph 431)	670
Preparatory works on 141 acres at Rs. 1–1–0 per acre (vide paragraph 431)	150
Tending natural regeneration on 100 acres at Rs. 2–8–0 per acre (vide paragraph 431)	250

Particulars.	Amount.
	RS.
(c) Puttur Felling Series ' B '—	
Production of 3,000 c.ft. of logs at As. 11–6 per cubic foot	2,160
Production of 4,180 broad gauge sleepers atRs. 4–6–3 each	18,350
Production of 2,770 metre gauge sleepers at Rs. 2–4–9 each	6,190
Production of 5,000 c.ft. of scantlings at Rs. 1–6–6 per cubic foot (vide paragrapah 122)	7,030
Preparatory operations over 95 acres at Re. 1–1–0 per acre (vide paragraph 431)	100
Tending natural regeneration over 50 acres at Rs. 2–8–0 per acre (vide paragraph 431)	130
Artificial regeneration on 36 acres at Rs. 7–8–0 per care (vide paragraph 431)	270
(d) Uppinangady Felling Series—	
Production of 42,970 c.ft. of logs at As. 9–9 per cubic foot	26,180
Production of 6,300 broad gauge sleepers at Rs. 3–13–0 each (vide paragraph 122)	24,020
Production of 4,200 metre gauge sleepers at Rs. 1–13–6 each (vide paragraph 122)	7,740
Production of 8,000 c.ft. of scantlings at Rs. 1–1–6 per cubic foot (vide paragraph 122)	8,750
Artificial regeneration of 50 acres at Rs. 40 per acre (vide paragraph 431)	2,000
Tending natural regeneration over 35 acres at Rs. 2–8–0 per acre (vide paragraph 431)	90
2 Clear-felling Working Circle—	
Production of 20,000 c.ft. of logs at 11 annas per cubic foot	13,750
Production of 740 broad gauge sleepers at Rs. 3–14–0 per sleeper (vide paragraph 122)	2,870
Production of 900 metre gauge sleepers at Rs. 1–14–0 per sleeper (vide paragrapah 122)	1,690
Formation of 80 acres departmentally at Rs. 30 per acre	2,400
Formation of 80 acres of kumri plantation at Rs. 12 per acre (vide paragraph 470)	960
Formation of 40 acres in Nerankimale at Rs. 22 per acre (vide paragraph 525).	880
Tending 200 acres at Rs. 10 per acre	2,000
3 Plantation Working Circle—	
Tending 1,800 acres of plantations under shelterwood at Re. 1–4–0 per acre (vide paragraph 441)	2,250
Tending 80 acres of old kumri plantations at 12 annas per acre (vide paragraph 454)	60
4 Fuel Working Circle—	
Tending and regenerating in blanks, 425 acres at Rs. 4 per acre (vide paragraph 551)	1,700
5 Hopea Improvement Working Circle—	
Tending 1,110 acres at 8 annas per acre (vide paragraph 573)	550
6 Sandal Working Circle—	
Extraction, cleaning and transport of 15 tons of sandalwood at Rs. 70 per ton.	1,050
7 Items common to all working circles—	
Stores, tools and plant (vide paragraph 635)	5,600
Elephant capturing operations (vide paragraph 651)	3,500
Capital—Roads, buildings and demarcation—New works—	

	RS.
Approach road to Bantwadi (vide paragraph 623)	500
Improvements to Polangayam cart-track and extension to Kanthi Kumari (vide paragraph 625)	2,500
Approach road to Coupe V, Nalkur (vide paragraph 624-a) ..	1,000
Inspection shed at Kanthi Kumari (vide paragraph 632) ..	1,500
Improvements to Polangayam shed (vide paragraph 632) ..	350
Forest rest-house at Aranthodu, part cost (vide paragraph 630)	1,000
Demarcation, verification, survey and repairs to cairns ..	10,000
Total ..	16,850

Interest at 5 per cent for half the period of four years, as the works are proposed to be carried out progressively during this period		1,680
Old works—		
Murur-Kolchar road—two-thirds of the cost of construction	7,000	
Interest at 5 per cent for four years		1,400

Particulars.	Amount.
	RS.
Maintenance of roads and bridges—	
Thirty miles of unmetalled road at Rs. 30 per mile per annum for four years (vide paragraph 618)	3,600
Maintenance of buildings	4,000
Maintenance of wells	600
Fire protection—	
Protection of areas under regeneration included in the estimates of costs of formation	Nil.
Fire-tracing of road margins and footpaths and reserve boundaries, say 550 miles at Rs. 3 per mile per annum (vide paragraph 636)	6,600
Early burning, pay of fire patrols in specially protected areas at Rs. 800 per annum	3,200
Establishment—	
Pay of District office establishment—	
Pay of District Forest Officer at Rs. 750 per mensem	36,000
Pay of gazetted assistant at Rs. 375 per mensem	18,000
Pay of office establishment at Rs. 480 per mensem	23,040
Pay of one special duty Ranger at Rs. 100 per mensem	4,800
Pay of Range establishment—	
Kasaragod Range at Rs. 1,100 per month	52,800
Puttur Range at Rs. 590 per month	28,320
Uppinangady Range at Rs. 545 per month	26,160
Allowances—	
Travelling and other compensatory allowances at Rs. 10,000 per annum (past average was Rs. 11,500 but this figure reduced owing to retrenchment)	40,000
Contingencies—	
Rupees. 2,500 per annum (past average was Rs. 2,900, but this figure reduced owing to retrenchment)	10,000
Direction—	
Annual direction costs of the Conservator, VI Circle, amount to Rs. 44,000. The proportionate charge allotted to South Kanara district is one-fifth; one-half of this is taken to South Mangalore Division, or one-tenth of Rs. 44,000	17,600
Total for four years ..	5,54,960
Average annual expenditure ..	1,38,740
Average annual revenue ..	1,44,000
Average annual surplus ..	5,260

Section 2.—Cost of the Working Plan.

690. *The cost of the working plan is as follows* :—

Budget head.	Amount. RS.	A.	P.
52-A. (*f*) Regeneration—			
Pay of officers—Non-voted *	27,312	11	0
Pay of officers—Voted	3,681	1	0
Pay of establishment—Voted—			
Permanent	11,288	9	0
Temporary	889	14	0
Travelling allowances—			
Non-voted	6,670	5	0
Voted	8,275	0	0
Fixed travelling allowance	615	3	0
Other compensatory allowances	662	1	0
Contingencies	997	9	0
Purchase of stores	68	0	0
Works	2,666	2	0
Total ..	63,104	7	0

* Pay of Officers—Non-voted includes overseas pay. The cost of the working plan works out to As. 3-1·7 per acre on the entire division.

SUMMARY OF PRESCRIPTIONS.

CHAPTER I.—BASIS OF PROPOSALS.

Sub-title and summarized prescriptions.

	PARA.	PAGE
Working Circles—		
Eight working circles have been constituted :—		
(*a*) The Plains and Foot-hills Timber Working Circle ; area 26,280 acres	273–277	103–105
(*b*) The Protection Working Circle ; area 215,044 acres	278–280	105
(*c*) The Plantation Working Circle ; area 4,781 acres	281, 282	105
(*d*) The Hopea Improvement Working Circle ; area 4,247 acres ..	283	105–106
(*e*) The Clear-felling Experimental Working Circle ; area 304 acres (excluding kumris)	284, 285	106
(*f*) The Fuel Working Circle ; area 4,399 acres	286	106
(*g*) The Minor Produce Working Circle	287	106
(*h*) The Sandal Working Circle	288	106
Period and revision of the plan—		
The working plan will take effect from 31st March 1931. Revision of the plan should be taken up in 1941	289	106

CHAPTER II.—THE PLAINS AND FOOT-HILLS WORKING CIRCLE.

	PARA.	PAGE
Area—		
The present area of the working circle is 26,280 acres. Further additions may be made at future revisions	290	107
Limits of the working circle are purposely very loosely defined	300	111
Areas suggested for future inclusion are shown on the Management Maps (scale 1″ to 1 mile)	323	117
Immature areas now in the Protection Working Circle will in due course be transferred to this working circle	324	117
The Crop—		
Component areas at present comprise only the best-stocked and most mature timber forest up to the limits of economic exploitability. All vegetational types are included	291	107
Division of the Area—		
The unit of management is the 'Regeneration Area.' There are no rigidly-defined periodic blocks	292, 293	107
No permanent compartments have been formed	294	107
Annual coupes are denoted by Roman numerals ; these will be shown out painted on boards of durable timber at corners of all coupes, together with the year of felling	295	107
Stock-mapping—		
The entire area of the working circle has been stock-mapped	297	108
Analysis of the crop—		
Tabular statements are given	298	108–110
Outline of policy—		
Contraction of output of timber appears at present desirable, owing to depressed trade conditions, a glut of timber in the West Coast depots and a preponderance of immature timber in the forests of the division.	300	111
Capital outlay at present must be restricted to the minimum, and expenses on regeneration must not be excessive	301	111
Enumerations in unreserves indicate that extraction from them may be carried on for some years thus permitting preparatory operations in evergreen areas to be accomplished in advance of fellings	301	111
Mixed irregular forests with a preponderance of utility species are desirable in South Kanara	302	111
An increasing extent should come under evergreen crops. Reasons are given	302	111
Regeneration operations in future should aim at ensuring regeneration either naturally or artificially in the gaps created by the removal of trees. Extensive plantations are not contemplated. A group-selection system will be adopted which gives ample discretion to the District Forest Officer	303	112
Frequent changes in staff are inadvisable	304	112
Record of works should be carefully maintained. Possibilities of external markets should be investigated	305	112

	PARA.	PAGE
Preliminary exploitation from unreserves—		
Anticipated to continue until the year 1936–37	306	112
Reserves will not be worked in the meantime	307	113
General system of management—		
The system, while not identical with any of the conventional ones, corresponds most closely with that known as the 'Irregular shelter-wood system,' or 'Swiss Femelschlag.' Reasons together with the principal advantages and disadvantages of the proposed system are discussed	308–312	113–114
Rotation—		
No definite rotation is fixed. A nominal rotation of 90 years is adopted, corresponding to the approximate average age of trees felled	313	114
The Regeneration area—		
The area proposed for felling and regeneration covers 10,230 acres..	314	115
This area corresponds to what would be the 'First Periodic Block' under the Uniform System	310	113
Revision and reconstitution of the Regeneration Area—		
The Regeneration area will be liable to revision and reconstitution at ten-yearly intervals. Areas effectively regenerated at the time of revision may be thrown out and fresh areas taken in. This should be done by the Working Plans branch. The size of the regeneration area may be increased as occasion demands up to a maximum of one-third of the total accessible timber-bearing forests of the division, provided that staff is adequate to deal with it	322	116
Regeneration period—		
A period of 30 years is deemed normally adequate for the purpose of regenerating the area	316	115
In order that a sustained outturn of certain species be secured for the future, a maximum period of 45 years is allowed in the regeneration of certain blocks	320	116
Felling cycle—		
A felling cycle of 15 years is adopted. The whole of the present regeneration area should be gone over once during that period ..	333	118
Calculation of possibility—		
The possibility is calculated solely on the stock in the present regeneration area, not on that of the entire forest tract. The method utilized is that known as Judeich's 'Bestandswirtschaft.' The total net yield during the first felling cycle is estimated at 1,252,500 c.ft., or an average annual outturn of 83,500. This figure excludes certain doubtfully saleable species. Frequent revisions are essential ..	326–331	117–118
Exploitable girth limits—		
For evergreen species, 6′ 0″; for *Terminalia paniculata*, 6′ 0″ (but may be reduced, if markets can absorb greater quantity of this species); for *xylia xylocarpa* 4′ 0″; for all other deciduous species, 5′ 0″. Reasons are discussed. The system permits retention of selected stems to reach superior dimensions for special markets	315	115
Regulation of the yield—		
Yield is regulated by the area of annual coupes on the basis of estimated volume contents obtained from proportional enumerations	332	118
Felling series—		
Four felling series are proposed and named according to the range in which situated. There are two separate series in Puttur Range, viz., Puttur Felling Series 'A,' and Puttur Felling Series 'B.' Other series are in Kasaragod and Uppinangady Ranges respectively ..	334	118
Felling and extraction—		
(i) *Survey and demarcation.*—Coupes will be surveyed and demarcated before the end of December of the year before felling is normally due..	335	120
(ii) Preliminary marking will be completed by February of the year prior to felling	336	120
(iii) *Silvicultural marking and check.*—Prior to felling the District Forest Officer or a gazetted assistant will make a silvicultural re-marking over the entire area of the coupe, and will make a detailed check of the accuracy of the original marking over not less than 10 per cent of the area. Guiding principles in silvicultural marking are given ..	337	120
(iv) *Extraction plan.*—The District Forest Officer will prepare a statement showing the general arrangements for extraction, lay-out of temporary cart-tracks, etc. He will also prepare a sketch-map of the area, and submit with estimate of costs to the Conservator	338	120

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	PARA.	PAGE
(v) *Felling and logging.*—" Advance fellings " will probably be necessary in all principal felling locations. Normal fellings will be arranged so that extraction is completed by the middle of October. Instructions are given in the logging, dressing, measurement and record of logs in the coupe	339	120
(vi) *Dragging and extraction.*—Dragging will be done by Government elephants. Drag-paths will be aligned before dragging is commenced. All dragging to cease by March 31st. Temporary cart-tracks to be constructed minimizing dragging ; these to be laid out with a view to easy extension into adjoining coupes	340	121
(vii) *Carting.*—Necessary arrangements to be made to keep carting well in pace with extraction ; the dry weather season to be utilized to the maximum	341	121
(viii) *Rafting.*—Logs to be rafted from depots immediately after heavy floods have subsided. Bamboos to be collected by the contractor..	342	121
Sawing—		
Logs will be cross-cut into suitable lengths at stump-site or at forest depots. Instructions are given in sleeper and scantling conversion.	343	121
Stacking—		
Instructions for stacking in forest depots are given	344	122
Regeneration of the coupe—		
General principles are laid down in summary form. These provide that—		
(*a*) a satisfactory stocking to be obtained on the regenerated portions of the coupe during the regeneration period ;		
(*b*) established regeneration over at least one-third the area of the coupe to be aimed at during each felling-cycle ;		
(*c*) natural regeneration to be encouraged to the maximum possible ;		
(*d*) artificial regeneration to be limited to a maximum of one-quarter of the area of the coupe during any one felling-cycle ;		
(*e*) the gaps created by the fellings must be regenerated satisfactorily ;		
(*f*) all areas under regeneration to be fire-protected ;		
(*g*) all areas under regeneration to be excluded from grazing for seven years after felling	346	123
Suitability maps—		
These are maps drawn of each coupe after survey and demarcation, to a scale of 16" to 1 mile, showing topographical features and all important data pertaining to regeneration of the coupe. These maps, one of which will be supplied to the Range Officer, will be used subsequently to felling, to show the progress of regeneration works in the coupe, and will also show the numbers and locations of the gaps made by the fellings	347	123
Regeneration of deciduous forests—		
General instructions are given in the regeneration of the several types of deciduous forest as under—	348	123
(*a*) advance regeneration of *Xylia* and modified light-demanders present	350	124
(*b*) semi open localities possessing regeneration of light-demanding species	351	124
(*c*) moist localities containing advance regeneration of Hopea. *Artocarpus hirsuta*, etc.	352	124
(*d*) localities containing a negligible quantity of advance regeneration	353–356	125
(*e*) Localities containing growth-types inimical to the regeneration of tree-species (e.g., *Strobilanthes*, Lantana, *Ochlandra* reed, climbers, etc)	357	126
Regeneration of *Hopea parviflora*—		
A general note on the conditions requisite for raising *Hopea parviflora* is made with reference to the following :—	358	126
(*a*) Limiting factors influencing growth	359	126
(*b*) Indications of suitability of locality	360	127
(*c*) Choice of locality for artificial regeneration	361	127
(*d*) Progressive stages of development, and general sequence of operations	362	127
(*e*) Protection against disease	363	128

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Artificial regeneration of Hopea—		
(i) *Selection of site.*—Careful selection by the District Forest Officer essential. Sites selected will be marked on the "suitability map." Uniform plantations over whole coupes or compartments are not to be undertaken without special sanction of the Conservator ..	364	128
(ii) *Year of sowing.*—Sowing normally done in the year after felling, provided ample protective ground-flora and residual shade	365	128
(iii) *Collection of seed.*—Newly fallen seed should be collected from the ground immediately before required for sowing. Statistics of seed-collection are given	366	128
(iv) *Nursery.*—Seedlings to replace casualties to the extent of 15 per cent in the current year, plus 25 per cent in the sown area of the previous year are to be raised in a nursery constructed under shelter and in moist surroundings. Instructions for forming the nursery are given. Seeds to be sown broadcast but not too thickly in beds 24—30 feet long and 4 feet broad. Heavy drip to be guarded against. The beds to be kept watered in hot weather. Pandals will be erected if necessary. *Artocarpus hirsuta* is preferably raised in the same nursery but in different beds. Seedlings up to 3 years old will be required ; these should be thinned out in the second year. The nursery may require fencing	367	128–129
(v) *Sowing and planting.*—Aligning and staking to be done in February or March. Accuracy to be subordinated to cheapness. Espacement will ordinarily be 9′ × 9′	369	129
Soil-working is prescribed in patches at each stake 1 foot square and 10 inches deep ; if soil is hard laterite the depth to be 12 inches. Work should be completed by the 15th May	370	129
Sowing will be completed within two days of collection of seed and by about the 7th of June. Ten to twelve seeds will be lightly dibbled at each patch	371	129
(vi) *Replacement of casualties*—		
First-year casualties—First replacement will be in July, and subsequently as they occur. Replacements taken from surplus seedlings at stake or from the nursery	372	129
Second-year casualties—These will be replaced by one-year old seedlings from the nursery	372	130
No further replacements will ordinarily be undertaken	372	130
(vii) *Weeding and climber-cutting*—		
First weeding in the second year of formation should be very light and may be omitted at discretion	373	130
Second weeding in the third year to a distance of 3 feet around each patch	373	130
No definite programme of weeding subsequently is laid down ; frequency will depend on individual circumstances. Weeds must be kept below the level of the heads of Hopea seedlings and the space around each patch should be kept clear. Climbers to be cut at the same time as the weeding. A weeding should invariably follow years of subsidiary shade removal	373	130
(viii) *Pruning.*—Not necessary until plants are thoroughly established. Double leaders should be pruned after the plant is 6 feet high. Damaged stems to be cut back to within 3 inches of the ground at any time observed	374	130
(ix) *Removal of diseased plants.*—Ill-favoured and diseased plants should be removed by uprootal during tending operations and burnt.. ..	375	130
(x) *Reduction of shade.*—A fixed programme of shade removal is inadvisable. The District Forest Officer shall inspect regenerated localities when the crop is 5 years old. He will prescribe as he thinks fit for shade reduction.		
In the ninth and tenth years the revising officer will examine the area as a whole.		
The manner of performing the operation of shade removal is prescribed.	376, 417–424	130, 138–139
Measures for the natural regeneration of Hopea and other evergreen species—		
Operations are classified under— (*a*) Operations to precede felling of the mature crop ; (*b*) Exploitation of the mature crop ; (*c*) Subsidiary operations after felling.	377	130
The advisability of preparatory operations commencing some five years prior to exploitation is explained	378	131
Classification of areas into four classes according to the density and condition of useful regeneration is prescribed	379	131

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The preparatory operations consist of removal of low shade for a radius of 15 yards around seed-bearers, and the cutting of undergrowth in the regions of natural regeneration. The maximum advantage of a good seed-year should be taken	380	131
Fourth year.—A marking is made in the year preceding felling. Even distribution of residual canopy is required. General instructions are given	382	132
Fifth year.—A regeneration felling and removal of the mature crop is prescribed	383	132
Sixth year.—Inspection paths, tending of natural regeneration, and artificial sowing and planting	384–386	132
Instructions given in the tending of species other than Hopea. More than 500 seedlings, saplings or young poles up to 3″ diameter per acre of certain accessory species may be considered adequate regeneration without Hopea	387	133
Seventh year.—Replacement of casualties ; weeding and climber-cutting if necessary	388, 389	133
Eighth to tenth years.—Weeding, climber-cutting and general tending by the beat-guard. In the tenth year the District Forest Officer should inspect the coupe and make necessary entries in the Control Journal. He should also prescribe what future works are necessary	390	133
Eleventh to fourteenth years.—Operations according to requirements of the crop and as ordered by the District Forest Officer	391	133
Regeneration in gaps.		
General objects—		
The general objects to be borne in mind during the period of the working plan are defined	392, 393	133–134
Selection of gaps—		
The District Forest Officer will select and mark those gaps which require artificial regeneration. The position of the gaps to be shown on the coupe map	394	134
Choice of treatment—		
General instruction given	395	134
Regeneration of deciduous species.		
Size of gaps—		
The minimum size of the gaps will be 8 yards square	396	134
Piling debris—		
The crownwood and felling debris will be cut and piled evenly over the ground in the gap	397	134
Burning—		
The piled debris is burnt in March	398	134
Fire-protection—		
The coupe will be fire-protected all round the periphery to a width of 12 feet before burning is begun	399	134
Staking and soil working—		
Gaps will be staked out at intervals of 4½ feet. The soil at each stake to be worked to a depth of 10 inches	400	134
Teak stumps—		
Teak stumps will be introduced where soil appears favourable. Stumps will be planted only in the very centre of the gaps, and will occupy not more than one-half the area of the gap	401	134
Other species—		
Other species such as *Dalbergia latifolia, Terminalia tomentosa* and *Pterocarpus marsupium,* will be used when teak is unsuited	401	134
Regeneration with evergreen species.		
General—		
General instructions when to use are given	403	134
Size of gaps—		
Gaps to be no larger than those caused by the actual fall of the tree. The gap caused by the crown not to be neglected	404	135
Clearing gaps—		
Gaps are to be cleared of branchwood and debris after extraction ; damaged seedlings and valuable regeneration to be cut back	405	135

	PARA.	PAGE
Espacement—		
Normal espacement of stakes will be 4½ feet. Stakes will be put around the margin of the gap for a distance of 5 or 6 yards into surrounding forest	406	135
Choice of species, etc. —		
General instructions on the choice of species, use of transplanted seedlings and stump-transplants	407	135
Soil-working and sowing—		
Soil at stakes to be loosened during May to a depth of 10 inches. Sowing to be completed by 7th June. Broadcast sowing may be tried	408	135
Tending of regeneration in gaps.		
Casualties—		
Casualties shall be replaced during the first year as they occur, in the second season by stumps or one-year old nursery transplants according to the species introduced	409	135
Tending—		
No special programme of weeding or tending is provided apart from the tabulated statements for the whole coupe. The importance of full stocking in the gaps during the first year is emphasized. Climber-cutting will be done along with weedings. The Provincial Silviculturist must be periodically consulted	410	135
Experimental.		
(i) Sowing of Hopea without aligning and staking	412	136
(ii) Regeneration of moist, semi-blank areas containing stunted tree-growth by dibbling Hopea and *Artocarpus* under partial shade ..	413	136
(iii) Experimental regeneration of a coupe by broadcast sowing of Hopea during the next two good seed-years is prescribed	414	136
(iv) Experiments in the effects of controlled burning of undergrowth are prescribed in Mujur block	415	137
(v) An experiment in the effect of burning undergrowth under parent trees in evergreen forest where regeneration is sparse is prescribed for 1933	416	137
Other subsidiary operations.		
Reduction of overhead canopy from established Hopea seedlings.		
Silvicultural markings—		
General instructions are given. The nature of the fellings is defined ..	417, 418	138
The middle storey best marked for removal after trees of the top canopy are removed. The degree of marking will be modified by circumstances, which are described	419	138
A climber-cutting to be performed in the upper canopy at the same time as the marking	420	139
Fellings—		
Felling and extraction will be made under the ordinary rules. Subsidiary instructions in the removal of small evergreen trees are given	421	139
Felling the young crop—		
After felling, all seedlings obscured by debris shall be freed. Other tending details are described	422	139
(ii) *Further fellings to remove shade.*—No precise programme of works formulated, but the District Forest Officer shall inspect the entire coupe five years after the above operations are done ; future requirements of the crop to be entered in the Control Journal, with year of each operation	423	139
Felling in compartments not in the Regeneration Area.		
For special markets—		
Mature and overmature timber for special markets may be felled from any part of the forest with the following girth-limits :— (i) for deciduous species, 9 feet, (ii) for evergreen species, 12 feet	427	140
Improvement fellings—		
Fellings with the object of realizing stems which cannot survive until the compartment is regenerated are permitted but not definitely prescribed. Instructions are given	428	140
Fellings with the object of benefiting immature pole crops without resulting revenue are not prescribed during the current period of the plan	428	140

	PARA.	PAGE.
Cleanings and thinnings in Hopea crops.		
Cleanings—		
The District Forest Officer will prescribe for first-class area at every quinquennial inspection	425	139
Thinnings—		
General instructions are given	426	140
CHAPTER III.—THE PLANTATION WORKING CIRCLE.		
Improvement fellings in teak kumries—		
General instructions. The District Forest Officer or gazetted assistant should supervise the marking	444–450	152
A five-year cycle of operations is adopted	451	152
Weedings, cleanings, etc., in the young clear-felled plantations—		
To be carried out in conformity with prescriptions laid down for the Clear-felling Working Circle	453	152
Weedings, cleanings, etc., in Hopea plantations—		
All tending, including reduction of shade to be done in conformity with paragraphs 373—376 of the Timber Working Circle	460	158
Treatment of failed areas in Hopea plantations—		
Prescriptions and suggestions for restocking the areas	457	154, 155
Quinquennial examination by the District Forest Officer—		
Plantations to be examined and reported on once in every five years as laid down in tabular statement of operations. The District Forest Officer will record observations in the Control Journal	459	157
Thinnings—		
A light thinning in Hopea broadcast sown plots in about the 20th year ..	461	157
In regular Hopea plantations, a thinning probably necessary between 25th and 30th years, but no definite rules given	461	157
Tabular statement of operations—		
According to locality	454, 458	152–153 155–156
CHAPTER IV.—THE CLEAR-FELLING (EXPERIMENTAL) WORKING CIRCLE.		
Division of the area—		
The working circle is divided into six series. Of these Nos. 1 and 4 are known as " Departmental Felling Series " ; Nos 2, 3 and 6 are " Kumri Felling Series " of which No. 6 is provisional ; and No. 5 is worked in conjunction with the Fuel Working Circle	464, 470	157–158
Silvicultural system—		
Clear-felling with artificial regeneration	466	158
Species—		
Teak to be the primary species in the regenerated crop ; other auxiliary species are prescribed. Spontaneous growth of any good timber species to be encouraged to form a mixture	468	158
Size of coupes—		
Annual coupes will be 10—12 acres in each felling series ; coupes in kumri felling series may be enlarged to 60 acres after five years' experience, if desired	470	158
Survey and demarcation—		
To be done in January prior to year of felling	472	158
Marking—		
Instructions given	473	158
Creeper-cutting—		
To be done simultaneously with marking	474	158
Extraction—		
Dragging to be completed by the end of October	476	159
Clearing the area—		
Felling to be completed by middle of December ; debris heaped evenly over the area	477	159
Fire-lines—		
Cut 12 feet wide and burnt in February	478	159
Burning the area—		
To be performed as early as possible ; general instructions	479	159
Seed collection—		
Selection of seed-bearers ; instructions and useful data	480, 481	159

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Nursery—		
Selection of site	482	159
Size of nursery. Calculation of number of beds per acre	482	159
Nursery construction	483	160
Sowing and transplanting	484, 485	160
Protection and tending	486	160
Removal of plants from nursery	487	161
The Travancore method	488	161
Notching of germinating seedlings	489	161
Inspection prior to formation—		
District Forest Officer will inspect ; all relevant information about the coupe will be entered in the Control Ledger	491	161
Planting plan—		
Showing espacements and general arrangements for regeneration. Localities unsuited for teak to be marked on a scale plan of the coupe ..	492	161
Inspection paths—		
Six feet wide through centres of plantations. If kumried blocks larger than 10 acres, divide the coupe into sections not greater than 10 acres ..	493	161
Aligning and staking—		
Espacement recommended is 6 feet × 6 feet but may be reduced to 4½ feet × 4½ feet.	494	161–162
Pitting—		
Soil loosened in patches 1 foot square and 10 inches to 12 inches deep ..	495	162
Formation—		
Aim to produce the most complete degree of stocking possible (not only teak). Associates with teak to be *Dalbergia latifolia* and *Pterocarpus Marsupium*. *Terminalia tomentosa, Albizzia, Artocarpus* and *Acrocarpus* may be tried in non-teak soils	496, 498	162
Prescriptions applied to—		
(i) *Teak*.—All methods, sowing, planting, stumping, to be tried ; dibbling seed and planting out from nursery over 1 acre each for first five years ; remaining area by stumps.— *General instructions*—Sowing. Planting of nursery seedlings. Stump-planting	500	163
(ii) *Dalbergia latifolia*.—Generally successful from seed ; sow in the three outer rows of the teak plantation ; experiment to find out to what degree root-suckers survive ; experiment in dibbling along with teak at stakes	501	163
(iii) *Pterocarpus Marsupium*.—Sow in three outer rows ; experiment in dibbling along with teak	502	164
(iv) *Terminalia tomentosa*.—Sow in non-teak soils ; broadcast sowings and at stakes	503	164
(v) *Xylia xylocarpa*.—Artificial regeneration is not prescribed ; it will come in naturally	504	164
(vi) *Artocarpus hirsuta*.—Various methods prescribed on an experimental scale	505	164
(vii) *Albizzia species*.—Direct sowings in light soils	506	164
Weeding and soil aeration—		
First-year weeding.—To be done in lines on either side of the planted rows ; mamuti scraping and forking prescribed ; two, and possibly three weedings will be necessary	508	164
Second-year weeding.—As in first year ; soil aeration in heavy soils ..	509–510	164–165
Mulching—		
If necessary	511	165
Casualties—		
In first season as they occur ; second year casualties replaced by stumps early during the rains. Other general instructions	512	165
Cleanings—		
Necessary from third year until the plantation is out of danger. General instructions ; useful species to be retained as a supplementary crop ..	513	165
Tending—		
Pruning of double leaders, etc., prescribed unless cost prohibitive ..	514	165
Drainage—		
Catchment drains along contours on steep slopes in first season only ..	515	165

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Kumri series—		
Areas suitable for teak to be personally selected by District Forest Officer ; no definite coupes laid out ; the management will select convenient coupes in the areas indicated on the map	516	165
Works of formation to be done by kumridars under departmental supervision and paid for	517	165
Kumridars will weed during the first season	518	165
The department will take over entire charge after crops are harvested in October-November	519	165
No " rewards " to kumridars	521	165
The Shiradi kumri series may be opened at the discretion of the management	520	165
Nerankimale felling series—		
To be worked in conjunction with prescriptions of the Fuel Working Circle	523	166
Not less than 10 acres to be burnt and regenerated according to prescriptions of this working circle	525	166

CHAPTER V.—THE FUEL WORKING CIRCLE.

Felling series—		
The following are prescribed :—		
The Muliar-Karadka Felling Series—2,476 acres.		
The Narimogar Felling Series—880 acres.		
The Nerankimale Felling Series—980 acres.		
The Kalanjimale and Kunthur Series, now closed, may be reopened at the discretion of the management.		
Closure of series is advised rather than continuance of sale of coupes at non-competitive prices	533–540	167–168
Division of the area—		
Coupes are indicated in serial numbers as worked	541	169
Survey of the coupe—		
Coupes will be surveyed in January of the year preceding the felling ..	559	171
Demarcation—		
Coupes will be demarcated by a cleared line 10 feet wide before coupe is sold	559	172
Silvicultural system—		
" Simple coppice " is prescribed, with the exception of 10 acres annually in Nerankimale series to be regenerated in accordance with the prescriptions of Chapter IV	543	169
Rotation—		
The rotation is forty years ; reasons are adduced	544	169
Yield—		
Yield is regulated by area. The expected annual yields from the coupes of each series are given	545	169
Method of executing the fellings—		
Coupes will be advertised and sold in public auction	548	169
General instructions defining manner of cutting, dressing stumps, extraction roads, etc.	550	170
Regeneration—		
Coppice regeneration, supplemented by natural seedlings and rootsuckers.	552	170
Artificial restocking of blanks—		
Restricted to incompletely stocked areas of not less than ½ acre in extent. The Range Officer shall inspect the coupe before felling and mark areas to be regenerated artificially. General instructions on preparation and regeneration of such areas	553	171
Tending and climber-cutting—		
Will be done in November following felling. General instructions ..	554	171
A further climber-cutting will be carried out five years after felling ..	557	171
Inspection by District Forest Officer—		
Prescribed in the third year from formation	557	171
Grazing—		
All coupes will be closed to grazing and the exercise of concessions for five years after felling	558	171

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CHAPTER VI.—THE HOPEA IMPROVEMENT WORKING CIRCLE.		
Constitution and area—		
The area (4,247 acres) of this working circle overlaps other working circles. It contains natural Hopea seedlings and saplings. Hopea crops occupy 22,000 acres only	562, 563	172
Distribution—		
A tabular statement is provided	565	172, 173
Survey and demarcation of coupes—		
Coupes will be surveyed and demarcated by a line cut 6 feet wide in the year prior to that in which the operation is done. A sketch will be drawn to scale 4 inches to 1 mile	566	173
Cycle of operations—		
A tending cycle of six years is prescribed ; average areas of coupes are given	567	173
Treatment—		
Instructions given	568	173
Broadcast sown plots—		
In good seed-years, beat-guards to sow patches ½ to 1 acre in extent in suitable sites within their beats ; total extent in each beat not to exceed two acres	571	174
Tabular statement of operations—		
Given	573	174
CHAPTER VII.—THE PROTECTION WORKING CIRCLE.		
Area—		
This working circle covers all tracts not directly provided for under the foregoing working circles and its constitution is described in paragraph 278. The area is 196,069 acres	574	174
Stock-mapping—		
Practically the entire extent has been stock-mapped to types	575	175
Treatment—		
With the exception of those areas which are provided for under the Hopea Improvement Working Circle, the rest of the area will not be worked. The management may do " Improvement fellings "	576	175
The beat-guards should carry out climber-cutting over minimum areas of 50 acres annually	577	175
CHAPTER VIII.—THE MINOR PRODUCE WORKING CIRCLE.		
Area—		
This working circle comprises all the reserved forests and lands at the disposal of Government situated within the division	579	175
Method of sale—		
The existing system of annually leasing out in convenient farms shall be continued	580	175
' Naga ' canes—		
Removal of ' Naga ' canes shall not be leased out for the next five years. The lease when commenced again shall be given in alternate years ..	582	176
Cardamom—		
Cultivation of cardamom may be extended at the District Forest Officer's discretion	583	176
Cinnamon—		
Experiments in the distillation of Cinnamon bark and the cultivation of Cinnamon are prescribed	585–588	176, 177
Anacardium occidentale—		
Introduction of *Anacardium occidentale* in laterite blanks is prescribed in paragraph 553. Should this increase the value of minor forest produce leases, such planting operations should be extended especially in Kasaragod Range	589	177
CHAPTER IX.—THE SANDAL WORKING CIRCLE.		
All village lands including unreserves, kumakies and patta which contain sandal are included in this working circle. The area which may be said to contain sandal is about 16,000 acres	591	177
The results of an enumeration made in 1926 by the district staff are given..	592	178, 179
Past policy is discussed	593	179, 180
Outline of future policy is given	594	180, 181

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Prescriptions—		
All living sandal trees of and above 10 inches in girth and all dead trees and stumps containing scented wood shall be extracted. All patta sandal containing exploitable heart wood shall be extracted under agreements. All such sandal on darkhast lands shall be extracted before assignment	595	181
Felling cycle—		
Felling cycle will be six years	596	181
Fellings—		
Details as to the method of working are given	597	181, 182
A tabular statement of fellings is given	598	182
Propagation centres—		
Details as to the creation and upkeep of propagation centres are given..	599–609	182, 184
CHAPTER X.—MISCELLANEOUS PRESCRIPTIONS.		
Administrative changes—		
The Beltangady Range will be abolished	613	184
The area of Beltangady Range will be distributed between the Mangalore Range of North Mangalore Division and the Uppinangady Range of the South Mangalore Division	614	184
Roads—		
The maintenance of existing roads and cart-tracks is prescribed and details are given	618, 619	185
The construction of certain new roads is proposed—		
(1) Improvement to the road from the main Mercara trunk road to Bantwady	623	185
(2) A road from Aranthodu to Choripane	624	186
(3) An approach road to coupe No. V of felling series 'A'	624 (*a*)	186
(4) Improvement to the existing road to Polangayam	625	186
Buildings—		
The following new buildings are proposed :—		
(1) A range office at Kasaragod	626	186
(2) A range quarters at Kasaragod	627	186
(3) Quarters for the staff at Panathady, Panikere and Mukkudu beats.	628	186
(4) A double forest guards' shed at Jalsur	629	186
(5) A forest rest-house at Aranthodu	630	186
(6) A forest guard's hut at Devachalla	631	186
(7) Improvement to the shed at Polangayam	632	186
(8) Rest-houses at Panja and Dharmastala	633	187
Existing buildings and wells will be maintained in a proper state of repair	634	187
Stores, tools and plant—		
A sum of Rs. 15,000 is provided for this in the financial forecast ..	635	187
Fire-protection—		
Areas burnt to be immediately closed to grazing	637	187
Where fire-tracing is prescribed, the mode of procedure will be to cut two guide lines 5 feet wide and burn the intervening belt..	639	187
Plantations under shelterwood, all coupes under regeneration, blocks included in the regeneration area of the Timber Working Circle, all reserves included in the Fuel Working Circle and sandal propagation centres shall be fire-protected	641	187, 188
Road margins shall be fire-traced on both sides to a width of 15 feet. Exceptions to this are given	642	188
All rights of way and frequented paths will be fire-traced	642	188
Also reserves which are especially vulnerable to fires are to be fire-protected	643	188
Grassy areas on the ghats will be early burnt	644	188
The Kanara-Mysore boundary shall be cleared to a width of 10 feet on the Kanara side along portions ordered by the District Forest Officer.	645	188
Boundaries—		
Verification of the boundaries and rectification of defects are prescribed.	648	189
Elephant-capturing operations—		
Elephant-capturing operations in the division shall be resumed as early as is convenient for the management	651	189
Exploitation and utilization—		
Hand transport of sleepers will have to be arranged for in certain coupes.	652	189
Trial conversion of *Mesua* sleepers before undertaking conversion on a large scale is suggested	654	189
Details regarding the correct stacking of sleepers are given	655	190
Experiments in the conversion of sleepers are suggested	656–658	190

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Bamboo sale—		
No regular bamboo working is prescribed	659	191
Grazing—		
The existing rates for grazing within reserved forests will be maintained.	660	191
Research and statistics—		
Further collection of statistics for the preparation of volume tables is prescribed	662	191
Sample plots are prescribed to ascertain the ages of trees corresponding to girths and heights	663	191
Details regarding the maintenance and continuance of the existing sample plots in Hopea areas are given	665	191
Further entomological research is prescribed	666	192

CHAPTER XI.—ESTABLISHMENT AND LABOUR.

	PARA	PAGE
Establishment—		
One range, Beltangady, is abolished	674	192
The following additional establishment for Kasaragod Range is prescribed :—		
(1) A watcher for the Adur beat	670	192
(2) A watcher for the Mundekole beat	671	193
(3) Aletti East with its extension should be formed into a separate beat	672	193
(4) An additional watcher for Bantaje-Kannadka beat	673	193
One special duty Ranger for the division is prescribed	674	193
A gazetted assistant is essential	674	193
Labour—		
Special arrangements for housing coolies while working in Sampaje and Bantamale areas are prescribed	676	193

CHAPTER XII.—FINANCIAL FORECAST AND COST OF THE PLAN.

	PARA	PAGE
Financial forecast—		
The financial statement is made in two parts ; an unbalanced statement for the first six years of the plan during which unreserves will be worked and a balanced statement for the remaining four years	677	193
Estimates of the cost of production of timber are not based on the present reduced rates. Estimates of timber prices are pitched rather low based on the average of the recent past	678	193
The protective establishment, which is irreducible, constitutes a heavy charge on the division	681	194
The cost of establishment has been slightly reduced by the abolition of Beltangady Range	684	194
The revenue surplus anticipated in the working plan when in full working is small, being Rs. 4,060 per annum ; this compares with an average annual loss on the division in the recent past of Rs. 23,000	682, 685	195
Revenue for the last four years of the working plan period is Rs. 5,75,980.	688	196, 197
Expenditure for the above period is Rs. 5,59,760	689	197–199

APPENDIX I.

List of trees and shrubs common in South Kanara.

Serial number and Kanarese name.	Tulu name.	Botanical name.
1 Abanasi or Karimara	Karimara	*Diospyros ebenum.*
2 Abbolige	Abbolige	*Crossandra undulæfolia.*
3 Adike or Adake	Kang (Bajjeyi)	*Areca concinna.*
4 Adavibende	Adavibendekai	*Thespesia lampas.*
5 Adavigorante	Kadgorante	*Erythroxylon monogynum.*
6 Adavinimbe	Kadlimbe	*Atalantia monophylla.*
7 Adavimallige	Madirpuburu	*Jasminum rigidum.*
8 Adinji	Maryottimara	*Albizzia procera.*
9 Adikebuluballi	Arikeburu	*Pothos scandens.*
10 Adikegoli	Arikegoli	*Ficus mysorensis.*
11 Adsoge	Adsoge	*Adhatoda vasica.*
12 Agnimukhi	Jerkai	*Semecarpus anacardium.*
13 Ajanpatte	Gajamara	*Antiaris toxicaria.*
14 Akkarai	Yekkamale	*Calotropis gigantea.*
15 Agil	Agil	*Dysoxylum malabaricum.*
16 Alimar or Nemar	Alimar	*Memecylon edule.*
17 Akkasalle	Boldusaroli	*Olea dioica.*
18 Ame	Amemara	*Trema orientalis.*
19 Amate	Ambade	*Spondias mangifera.*
20 Amrithaballi	Amrithballibum	*Jinospora malabarica.*
21 Anagalu	Anaru	*Adina cordifolia.*
22 Andimuria or Andinar	Andipunar	*Carallia integerrima.*
23 Anechagate	Anethajank	*Cassia occidentalis.*
24 Anenar or Bannanar	Anenar	*Sterculia villosa.*
25 Antwalakai or Rinte	Nurekai	*Sapindus trifoliatus.*
26 Aranemullu	Aranemullu	*Limonia acidissima.*
27 Anilekai	Anilekai	*Terminalia chebula.*
28 Arasinagurgi or Garchanakuli	Punarapuli	*Garcinia morella.*
29 Aradala	Jarige	*Garcinia cambogia.*
30 Ashwatha or Arali	Athasmara	*Ficus religiosa.*
31 Athimara	Arthimara	*Ficus glomerata.*
32 Badambi	Badambu	*Terminalia catappa.*
33 Bagalu or Renje	Renjermara	*Mimusops elengi.*
34 Baine Baini	Indmara	*Caryota urens.*
35 Balige or Balagi	Balige	*Pœciloneuron indicum.*
36 Banapu or Mathi	Banpu	*Terminalia tomentosa.*
37 Bandanike	Bandanige	*Loranthus.*
38 Barigoli	Basrigoli	*Ficus infectoria.*
39 Batti	Pallimara	*Pongamia glabra.*
40 Binge	Benga	*Pterocarpus marsupium.*
41 Bendenaru	Bendnar	*Kydia claycina.*
42 Besoppu or Bevu	Besoppu	*Murraya exotica.*
43 Bhutakarulu or Narkolu	Bhutakarl or Narkol	*Helicteres isora.*
44 Bellesoppu	Bollethappu	*Mussœnda frondosa.*
45 Belpali	Bolpale	*Lophopetalum wightianum.*
46 Bilpathri	Bellapathri	*Aegle marmelos.*
47 Bilkambi	Bilkambi	*Albizzia stipulata.*
48 Bilinandi	Bolandoor	*Lagerstrœmia lanceolata.*
49 Bilitirupu	Bilitirupu	*Eugenia gardneri.*
50 Bogarimara	Bogarimara	*Zizyphus jujuba.*
51 Buruga or Mullala	Boradamara	*Bombax malabaricum.*
52 Chagategida	Thajank	*Cassia tora.*
53 Challa	Challa	*Lagerstrœmia flos-reginœ.*
54 Chakatte	Chakotte	*Schleichera trijuga.*
55 Chara or Chire	Thirfre	*Holigarna arnottiana.*
56 Challangai	Challangai	*Cordia wallichii.*
57 Churimullu or Ijemullu	Churimullu	*Cœsalpinia mimosoides.*
58 Daddala or Kaval	Daddal	*Careya arborea.*
59 Dalchini	Ijin	*Cinnamomum zeylanicum.*
60 Dhupa	Thandolige	*Vateria indica.*
61 Gajige	Gajige	*Cœsalpinia bonducella.*
62 Gandagarige	Gandhagiri	*Cedrela toona.*
63 Godda	Purlimara	*Odina wodier.*
64 Goli or Ala	Golidamara	*Ficus bengalensis.*
65 Gamate or Kavate	Kavati	*Xanthoxylum rhetsa.*
66 Gudane	Gudane	*Solanum indicum.*
67 Gugguldhupa	Gugguldhupa	*Ailanthus excelsa.*
68 Geru	Gonku	*Anacardium occidentale.*
69 Gurgi or Kurchil	Gurgi	*Strobilanthes.*
70 Halasu	Pela	*Artocarpus integrifolia.*
71 Hale	Palemara	*Altonia scholaris.*
72 Hebbalasu	Peja	*Artocarpus hirsuta.*
73 Honagalu or Hunilu	Punil or Marwa	*Terminalia paniculata.*
74 Hongaraka	Pongare	*Erythrina indica.*
75 Hurli	Purlikai	*Chikrassia tabularis.*
76 Holehonne or Kallhonne	Kallponne	*Calophyllum wightianum.*
77 Haluberu or Nannari	Namadaberu	*Hemidesmus indicus.*
78 Haiga or Karmar	Karmar	*Hopea wightiana.*

List of trees and shrubs common in South Kanara—cont.

Serial number and Kanarese name.	Tulu name.	Botanical name.
79 Ippe	Ippemara	*Bassia latifolia.*
80 Irippe	Irippe mara	*Buchanania latifolia.*
81 Itteru	Itteru	*Clerodendron infortunatum.*
82 Jajikai	Jaikai	*Myristica attenuata.*
83 Jala	Jaladamara	*Shorea talura.*
84 Kadshige	Katshige	*Acacia pennata.*
85 Kadbende	Kadbende or Koringi-mara.	*Trewia nudiflora.*
86 Kadiru or Kurundoti	Kadir	*Sida rhombifolia.*
87 Kakke	Kakkimara	*Cassia fistula.*
88 Kadambate	Kadambadi	*Spondias axillaris.*
89 Kakkesarli	Kakketharoli	*Disopyros sylvatica.*
90 Kalbhagi	Kallambege	*Albizzia odoratissima.*
91 Kalgarige	Kalgargi	*Soymida febrifuga.*
92 Kalli	Kalli	*Opuntia dillenii.*
93 Kanagalu or Muchil	Muchir	*Dillenia pentagyna.*
94 Kanapade	Kanapade	*Sapium insigne.*
95 Kansurgi	Koreji	*Ixora parviflora.*
96 Karemullu	Karekaimullu	*Canthium parviflorum.*
97 Karimenasu	Yeddemunichi	*Piper longum.*
98 Karmar	Karmar	*Hopea wightiana.*
99 Kasarka	Kayermara	*Strychnos nuxvomica.*
100 Kendasampige	Gendasampai	*Michelia champaka.*
101 Kiskara or Kisgara	Kepul	*Ixora coccinea.*
102 Kodsa or Maddarsa	Kodsa	*Holarrhena antidysenterica.*
103 Kokkekai	Kokkekai	*Tebernœmontana coronaria.*
104 Kottemullu	Kottimullu	*Zizyphus oenoplia.*
105 Kumılu	Kumil	*Gmelina arborea.*
106 Kunkuma	Kunkuma	*Mallotus philippinensis.*
107 Kuntinerale	Kuntal	*Eugenia caryophyllœa.*
108 Mandira	Mandira	*Bauhinia racemosa.*
109 Mandraphalu	Mapala	*Citrus medica-medica.*
110 Mannade	Mannadake	*Cordia myxa.*
111 Mashe	Mujamara	*Litsœa wightiana.*
112 Mavu	Kukku	*Mangifera indica.*
113 Mathi or Banapu	Banpu	*Terminalia tomentosa.*
114 Myrole or Thornukki	Myrole	*Vitex altissima.*
115 Nachikemullu	Nachikemullu	*Mimosa pudica.*
116 Nagasampige	Nagasampai	*Mesua ferrea.*
117 Naisonaguballi	Naisanang	*Mucana pruriens.*
118 Nanil	Nanil	*Bassia malabarica.*
119 Nakkare	Nekkare	*Olax scandens.*
120 Nainerale	Nainerole	*Eugenia arnottiana.*
121 Nanjıboru	Nanjiber	*Glycosmis pentaphylla.*
122 Narkolu	Narkole	*Helicteres isora.*
123 Nathahuvu	Nadelpu	*Lantana camara.*
124 Nedilu	Nedil	*Leea aspera.*
125 Neerulli	Neerulli mara	*Steriospermum chelonoides.*
126 Nelli	Nelli	*Phyllanthus emblica.*
127 Nemar or Alimar	Alimar	*Memecylon edule.*
128 Nerale	Nerole	*Eugenia jambolana.*
129 Nirvisha	Nirvisha	*Chasalia curviflora.*
130 Nugge	Nuruge	*Moringa pterygosperma.*
131 Ollekodi	Ollekodi	*Memecylon malabaricum.*
132 Ollemenasu	Yeddemunichi	*Piper longum.*
133 Ote	Vonte	*Ochlandra travancorica.*
134 Paccerengi	Pachrengi	*Tragia cannabina.*
135 Pajevu	Pajevu	*Ficus hispida.*
136 Palasha	Palasha	*Butea frondosa.*
137 Palashabulu	Palashaburu	*Butea superba.*
138 Perale	Perangal	*Psidium guayava.*
139 Ponnalike	Ponnalige	*Streblus asper.*
140 Pottushige	Pottushige	*Acacia intsia.*
141 Pulibhagi	Pulibhagi	*Albizzia stipulata.*
142 Raladhupa	Raladhupa	*Canarium strictum.*
143 Ramapathri	Ramapathri	*Myristica attenuata.*
144 Rudhraksha	Rudhraksha	*Elœocarpus tuberculatus.*
145 Sagvani	Thekki	*Tectona grandis.*
146 Sarale or Salle	Tharoli	*Aporosa lindleyana.*
147 Shanthi or Thari	Shanti	*Terminalia belerica.*
148 Siyala or Thengu	Bonda or Thare	*Cocos nucifera.*
149 Soorati or Soorante	Soorante	*Hydnocarpus alpina.*
150 Srihonne	Siriponne	*Calophyllum tomentosum.*
151 Thadsal	Thadsal	*Grewia tiliœfolia.*
152 Thiruva or Tiruva	Tiruva	*Xylia xylocarpa.*
153 Thumbe	Thumbe	*Leucas lanceœfolia.*
154 Uppalige	Uppalige	*Macaranga roxburgii.*
155 Uruki	Urki	*Urena lobata.*
156 Vayuvilanga	Vayuvilanga	*Embelia ribes.*
157 Votehuli	Yesalpuli	*Artocarpus lakoocha.*

List of trees and shrubs common in South Kanara—cont.

Serial number and botanical name.		Kanarese name.	Tulu name.
1	*Acacia intsia*	Pottushıge	Pottushige.
2	*Acacia sundra*	Katchu	Katch.
3	*Adina cordifolia*	Anagalu or Yethga	Anaru.
4	*Adhatoda vasica*	Adsoge	Adsoge.
5	*Aegle marmelos*	Bilpathri	Bellapathre.
6	*Ailanthus excelsa*	Gugguldhupa	Gugguldhupa.
7	*Albizzia odoratissima*	Kallbhagi	Kallambege.
8	*Albizzia stipulata*	Bilkambi	Bilıkambı.
9	*Alstonia scholaris*	Halemara	Palemara.
10	*Anacardium occidentale*	Geru	Gonku.
11	*Antiaris toxicaria*	Ajarpatte or Gajamara	Gajamara.
12	*Areca concinna*	Adike	Kang or Bajjiyi.
13	*Artocarpus hirsuta*	Hebbalasu	Pıja.
14	*Artocarpus integrifolia*	Halasu	Pıla.
15	*Artocarpus lakoocha*	Votihuli	Yesalpuli.
16	*Bassia latifolia*	Ippe or Durkulu	Ippe.
17	*Bassıa malabarica*	Nanil	Nanil.
18	*Bauhania racemosa*	Mandira	Mandira.
19	*Bombax malabaricum*	Buruga or Mullala	Boradamara.
20	*Buchanania latifolia*	Irippe	Irippe.
21	*Butea frondosa*	Palasha	Palasha.
22	*Butea superba*	Palashabeelu	Palashabum.
23	*Cæsalpinia bonducella*	Gajıge	Gajigekai.
24	*Cæsalpinia mimosoides*	Churimullu	Churimullu.
25	*Calophyllum tomentosum*	Srihonne	Siriponne.
26	*Calophyllum wightianum*	Kallhonne or Holehonne	Kallponne.
27	*Canarium strictum*	Raladhupa	Raladhupa.
28	*Canthium parviflorum*	Karemullu	Karemullu.
29	*Careya arborea*	Daddala or Kaval	Daddal.
30	*Carallia integerima*	Andinar or Andipunar	Andipunar.
31	*Caryota urens*	Baini	Ind.
32	*Cassia fistula*	Kakkemara	Kakkemara.
33	*Cassia occidentalis*	Anechagate	Anechagate.
34	*Cassia tora*	Chagatigida	Thajank.
35	*Cedrela toona*	Gandagarıge	Gandhagiri.
36	*Chasalia curviflora*	Nirvisha	Nırvisha.
37	*Chikrassia tabularis*	Hurli	Purlımara.
38	*Cinnamomum zeylanicum*	Dalchini	Dalchini or Ijin.
39	*Clerodendron infortunatum*	Ittevu	Ittevu.
40	*Cocos nucifera*	Siyala or Thengu	Bonda or Thare.
41	*Cordia myxa*	Mannadake	Mannadake.
42	*Dalbergia latifolia*	Biti	Biti.
43	*Dıllenia pentagyna*	Kanagalu or Muchiru	Muchil.
44	*Diospyros ebenum*	Karimara	Karimara.
45	*Diospyros sylvatica*	Kakkesarali	Kakketharoli.
46	*Dysoxylon malabaricum*	Agil or Belleagil	Agil.
47	*Vateria indica*	Dhupa	Thandolige.
48	*Elæocarpus tuberculatus*	Rudraksha	Rudraksha.
49	*Embelia ribes*	Vayuvilanga	Vayuvilanga.
50	*Erythrina indica*	Hongaraka	Pongare.
51	*Eugenia arnottiana*	Naıneralu	Nainerolu.
52	*Eugenia caryophyllœa*	Kuntınerale	Kuntal.
53	*Eugenia gardneri*	Bılitirupu	Bilitirupu.
54	*Eugenia jambolana*	Nerale	Nerolu.
55	*Ficus bengalensis*	Golimara	Goli.
56	*Ficus glomerata*	Athimara	Arthikaimara.
57	*Ficus hispida*	Pajeru	Pajeru.
58	*Ficus infectoria*	Basrıgoli	Basrigoli.
59	*Ficus mysorensis*	Adikegoli	Arikegoli.
60	*Ficus religiosa*	Ashwatha	Athasa.
61	*Garcinia cambogia*	Aradala	Jarige.
62	*Garcinia morella*	Garchanahuli	Punarpuli.
63	*Glycosmis pentaphylla*	Nanjiberu	Nanjiber.
64	*Gmelina arborea*	Kumilu mara	Kumil.
65	*Helicteres isora*	Bhutakarlu or Narkolu	Narkolu.
66	*Hemidesmus indicus*	Haluberu or Nannari	Namadaburu.
67	*Holarrhena antidysenterica*	Kodsa or Maddarsa	Maddarsa.
68	*Holigarna arnottiana*	Chare	Theyre.
69	*Hopea parviflora*	Kiralbhogi	Kiribovu.
70	*Hopea wightiana*	Haiga or Karmar	Karmar.
71	*Hydnocarpus alpina*	Soorati	Soorante.
72	*Ixora parviflora*	Kansurgi	Koregi.
73	*Ixora coccinea*	Kiskara	Kepril.
74	*Jasminum rigidum*	Adavi mallige	Madirpuburu.
75	*Jinospora (malabarica)*	Amrıthabally	Amrithaballiburu.
76	*Lagerstrœmia lanceolata*	Bilinandi	Bilinandi.
77	*Lagerstrœmia flos reginœ*	Challa	Challa.
78	*Lantana camara*	Nathahoovu	Nadelpoo.
79	*Leea aspera*	Nedilu	Nedıl.
80	*Lucas lanceœfolia*	Thumbe	Thumbe.
81	*Limonia acidissima*	Aranemullu	Aranemullu.
82	*Lophopetalum wightiana*	Bolpale	Bolpale.
83	*Loranthus species*	Bandanike	Bandanige.
84	*Macaranga roxburghii*	Uppalige	Uppalige.
85	*Mallotus philippinensis*	Kunkuma	Kunkuma.
86	*Mangifera indica*	Mavu	Kukku.
87	*Memecylon edule*	Alimar or Nemar	Alimar.

List of trees and shrubs common in South Kanara—cont.

Serial number and botanical name.		Kanarese name.	Tulu name.
88	*Memecylon malabaricum*	Vollekodi	Vollekodi.
89	*Mesua ferrea*	Nagasampige	Nagasampige.
90	*Michelia champaka*	Kendasampige	Gendasampai.
91	*Mimosa pudica*	Nachikemullu	Nachikemullu.
92	*Mimusops elengi*	Renji or Bagalu	Renjirmara.
93	*Moringa pterygosperma*	Nugge	Nurge.
94	*Mucuna pruriens*	Naisonag	Naisanang.
95	*Murraya exotica*	Besoppu	Besoppu.
96	*Mussœnda frondosa*	Bellesoppu	Bollethappu.
97	*Myristica attenuata*	Ramapathri or Jaikai	Ramapathri.
98	*Ochlandra travancorica*	Vote	Vonte.
99	*Odina wodier*	Godda	Purlimara.
100	*Olax scandens*	Nakkare	Nekkare.
101	*Olea dioica*	Akkasalle or Bilisalle	Boldutharoli.
102	*Opuntia dillenii*	Kalli	Kalli.
103	*Phyllanthus emblica*	Nelli	Nelli.
104	*Piper longum*	Vollemensu or Karimanasu	Yeddimunuchi.
105	*Pœciloneuron indicum*	Balige	Balige.
106	*Pongamia glabra*	Batte or Pallemara	Pallemara.
107	*Pothos scandens*	Adikebeelu balli	Arikeburu.
108	*Psidium guayava*	Perale	Perangai.
109	*Pterocarpus marsupium*	Binge	Binga.
110	*Santalum album*	Ganila	Ganila.
111	*Sapindus trifoliatus*	Rinti	Nurekaimara.
112	*Sapium insigne*	Kanapade	Kanapade.
113	*Schleichera trijuga*	Chakate	Chakate.
114	*Semecarpus anacardium*	Agnimuki or Jerkai	Jerkai.
115	*Shorea talura*	Jala	Jala.
116	*Sida rhombifolia*	Kadiru or Kurundoti	Kadir.
117	*Solanum indicum*	Gudane	Gudane.
118	*Soymida febrifuga*	Kallgarige	Kallgarige.
119	*Spondias mangifera*	Amate	Ambade.
120	*Sterculia villosa*	Anenaru	Anenaru.
121	*Stereospermum chelonoides*	Neerulli	Neerulli.
122	*Streblus asper*	Ponnalike	Ponnalige.
123	*Strobilanthes species*	Gurgi	Gurgi.
124	*Strychnos nux-vomica*	Kasarka	Kayermara.
125	*Tabernœmontana Coronaria*	Kokkekai	Kokkekai.
126	*Tectona grandis*	Sagvani	Thekki.
127	*Terminalia belerica*	Shanti or Thari	Shanti.
128	*Terminalia Catappa*	Badambi	Badambu.
129	*Terminalia chebula*	Anile	Anile.
130	*Terminalia paniculata*	Marwa or Honagalu	Marwa.
131	*Terminalia tomentosa*	Banapu or Mathi	Banapu.
132	*Thespasia lampas*	Adavibende	Adavibende.
133	*Tragia cannabina*	Pacherengi	Pacherengi.
134	*Trema orientalis*	Ame	Amemara.
135	*Trewia nudiflora*	Kadbende	Kadbendmara.
136	*Vateria indica*	Dhupa	Thandolige.
137	*Vitex altissima*	Myrole or Thornukki	Myrole.
138	*Xanthoxylum rhetsa*	Kavate or Jumma	Kavate.
139	*Xylia xylocarpa*	Tirwa or Jambe	Tirwa.
140	*Zizyphus jujuba*	Bogarimara	Bogori.
141	*Zizyphus oenoplia*	Kottemullu	Kottemullu.

APPENDIX II.

CONTROL FORMS.

(Sixteen.)

CONTROL BOOK.

The Plains and Foothills Timber Working Circle.

Prescriptions of the working plan.					Operations carried out.											Remarks.
	Locality.					Locality.				Details of yield obtained.						
													Sawn produce.			
Year of felling.	Reserve.	Coupe No.	Area in acres.	Nature of fellings.	Year of felling.	Reserve.	Coupe No.	Area in acres.	Nature of fellings.	Species.	Number of trees felled.	Yield of logs in c.ft.	Kind.	Volume in cubic feet.	Percentage of yield.	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
									Puttur Felling Series 'A.'							
1937–38 ..	Jalsur East..	II	189	Regeneration fellings.	1937–38 ..	Jalsur East..	II	170	Regeneration fellings.	Xylia xylocarpa ..	800	16,200	Broad gauge sleepers 1,000.	3,240	20	170 acres by actual survey.
													Metre gauge sleepers 4,320.	6,480	40	
													Scantlings ..	2,430	15	
										Terminalia tomentosa.	310	15,000				
										Terminalia paniculata.	100	6,000				
										Lagerstrœmia lanceolata	15	700				

Ledger for Natural Regeneration.

Timber Working Circle.

Felling Series—

Reserve : Nalkur.
Compartment No. 2.

Year of first preparatory operation	.. ..	1935–36.
Year of second preparatory operation	.. ..	1936–37.
Year of timber felling	.. ..	1938–39.
Year of first removal of middle storey	.. ..	1941–42.
Year of second removal of middle storey	..	1944–45.

Extent of area under natural regeneration.

(*a*) At beginning of preparatory period	..	22 acres.
(*b*) Before timber felling	..	30 ,,
(*c*) Five years after timber felling ..	..	45 acres.

Subordinate staff in special charge—Forester Govindan.

Wages of coolies—6 annas per male cooly.
4 annas for a female or boy.

Expenditure and cost analysis.
1939–40 account.

Month.	Trenching and root wounding.	Staking.	Line cutting.	Weeding.	Creeper cutting.	Removal of middle storey.	Reduction in upper canopy.	Fire protection.	Miscellaneous. Details.	Miscellaneous. Cost.	Monthly total.	Remarks.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.		RS. A. P.	RS. A. P.	
January 1939	..	..	..	..	..	..	..	..	..	..	..	
February 1939	..	..	..	..	..	..	..	..	..	..	..	
March 1939	..	..	..	..	..	..	..	..	..	..	..	
Total ..	..	..	..	..	..	..	..	..	..	..	..	
Cost per acre ..	..	..	..	..	..	..	..	..	..	..	..	

		RS. A. P.
Cost of operations during 1939–40	.. ..	264 0 0
Cost of operations per acre 1939–40	.. ..	6 0 0
Total cost including past expenditure	.. .. ..	..
Total cost per acre	.. ..	7 4 0

Extent of natural regeneration in—

(1) First-class areas	..	20 acres.
(2) Second-class areas	..	15 „
(3) Third-class areas	..	15 „

Ledger for Artificial Regeneration.

Timber and Plantation Working Circles.

Felling Series—

1. Date of timber felling.
2. Date of clearing undergrowth.
3. Date of sowing or planting.
4. Species planted.
5. Espacement.
6. Preparation of soil.

Subordinate in special charge

Wages of coolies.

Month.	Abstract of cost. Aligning and staking.	Pitting.	Cost of seed or nursery.	Dibbling original.	Stump planting original.	Planting original.	Replacement of casualties.	Weeding.	Soil working.	Removal of low shade.	Removal of top canopy.	Fire protection.	Miscellaneous.	Total cost of each month.	Percentage of stocking.
(1)	2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	16)
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	
Total ..															
Cost per acre ..															

Cost for the year 1932–33	..
Total cost including previous expenditure	..
Average cost per acre	..

Ledger for Artificial Regeneration of Gaps.

Year of regeneration 1938–39.
Number of gaps regenerated
Deciduous 400)
Evergreen 800)
Average size of gap—
Deciduous 30′ × 30′
Evergreen 20′ × 20′.
Average number of patches per gap.
Species introduced—
Hopea prviflora,
Artocarpus hirsuta.
Teak.
Dalbergia latifolia.

Felling Series : Puttur 'A.'

Coupe No. II—Area 42 acres.
Subordinate staff in special charge—Forester Achutan.

Wages of coolies—
6 annas for a male cooly.
4 annas for a female or boy.

Analysis of cost 193 —193 *account.*

Month.	Cutting slash, billeting and heaping.	Burning the heaps.	Staking and preparation of ground.	Cost of seed.	Sowing at stake.	Stump planting.	Cost of nursery.	Replacement of casualties.	Weeding and soil working.	Fire protection.	Other expenditure with details.	Monthly totals.	Remarks.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	
							Deciduous.						
November 1938	40 0 0	..	..	..	..	..	..	..	..	..	..	40 0 0	
March 1939	..	16 0 0	..	..	..	..	..	..	..	..	..	16 0 0	
April 1939	..	..	40 0 0	8 0 0	5 0 0	..	..	..	..	..	..	53 0 0	
May 1939	..	..	..	..	..	16 0 0	5 0 0	..	..	..	..	21 0 0	
July 1939	..	..	..	..	..	..	..	8 0 0	16 0 0	..	..	24 0 0	
October 1939	..	..	..	..	..	..	..	..	10 0 0	..	..	10 0 0	
Total ..	40 0 0	16 0 0	40 0 0	8 0 0	5 0 0	16 0 0	5 0 0	8 0 0	26 0 0	..	..	164 0 0	
Cost per acre ..	..	..	..	..	..	..	..	..	..	..	..	..	
							Evergreen.						
Total ..													
Cost per acre ..													

	Deciduous. RS. A. P.	Evergreen. RS. A. P.
Cost during the year 1938–39	164 0 0	..
Average cost per acre	38 0 0	..
Average cost per gap	2 4 0	..
Total cost at the end of the year including previous expenditure.	228 0 0	..
Average total cost per acre	44 0 0	..
Average total cost per gap	2 8 0	..

Number of gaps successfully stocked with established regeneration—360.

Note.—This form will be used for gap regeneration in the Timber Working Circle. In the case of Felling Series 'A' and 'B' of Puttur Range, and similar evergreen localities, column (2) will be altered to 'clearing the ground' and column (3) will not be required.

Control Book.

Clear-felling (Experimental) Working Circle.

Felling Series........

Prescriptions of working plan.				Operations carried out.								
Year of felling.	Coupe No.	Area in acres.	Nature of felling.	Year of felling.	Coupe No.	Area in acres.	Nature of felling.	Species and form of produce.	Number of trees felled.	Number of logs or units of other produce.	Volume in cubic feet.	Remarks.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
1935–36 ..	III	20	Clear-felling ..	1935–36 ..	III	19	Clear-felling ..	Terminalia tomentosa ..	56	62	3,060	On actual survey and plotting the coupe was found to be only 19 acres. Trees of utilizable species of and above 4 feet girth at breast-height were converted.
								Xylia xylocarpa	60	61	1,400	
								Terminalia paniculata ..	40	51	2,000	
								Total ..	**156**	**174**	**6,460**	

Regeneration Ledger for the Clear-felling (Experimental) Working Circle.

Felling Series—Todikan.
Coupe number 7.
Area in acres 10.

Short description of the area before felling (soil aspect, drainage, vegetation, over-wood and ground-flora).	Moderately deep, well drained red loamy soil. Aspect north-easterly. Predominant species Terminalia paniculata and Lagerstrœmia lanceolata. Xylia xylocarpa confined to hill top. Ground-flora is of varied composition ; in places it is of a transitional type, in others dry deciduous.
Area regenerated under each species introduced.	Teak 5·6 acres. Rosewood 2 acres. Pterocarpus marsupium 1·2 acres. Artocarpus hirsuta 1 acre. Miscellaneous species 0·8 acre.
Espacement	6′ × 6′.
Method of regeneration	Teak—Stump planting. Rosewood—Direct sowing in prepared patches. Artocarpus hirsuta—Planting two-year old stumps. Pterocarpus marsupium—Direct sowing. Miscellaneous species—Sowing.
Dates of sowing or planting of each species.	Teak—Planting—14th June 1936. Rosewood—Sowing—11th April 1936. Artocarpus hirsuta—Planting—11th June 1936. Pterocarpus marsupium and miscellaneous species—Sowing—13th April 1936.
Other remarks.	
Special difficulties encountered (pests, climbers, drought, etc.).	Although favourable weather prevailed for four days after planting, there was a continuous break of the monsoon for twenty-seven days with the result some seedlings died of drought.

Year of plantation	1936–37.
Date of timber-felling	November 1935.
Date of clear-felling	December 1935.
Date of burning	February 1936.
Date of second and third burnings	March 1936.
Agency of timber-felling and extraction	Departmental.
Agency of clearing and burning	Kumridars.
Agency of sowing and planting	Departmental.
If kumried, date of handing back to the department ..	November 1936.
Area allotted to each kumridar	2 acres.
Subordinate establishment in special charge	Forester Ramappa. Forest Guard Krishnan.
Rate of daily wages	RS. A. P. 0 6 0 per man cooly. 0 4 0 for a female or boy.
Other necessary information	
Percentage of stocking at beginning of second growing season.	67
Percentage of stocking at beginning of third growing season.	72

Regeneration Ledger for the Clear-felling (Experimental) Working Circle.

Felling Series :

Analysis of cost 1932–33 account.

Month.	Cost of operations.															Monthly rainfall in inches.	Remarks.
	Clear-felling.	First burning.	Heaping and reburning.	Aligning and staking.	Pitting.	Seed.	Nursery.	Dibbling (original).	Stump-planting (original).	Replace-ment of casualties.	Soil-working, weeding and tending.	Fire protection.	Inspection paths.	Other expenditure.	Monthly total.		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	14)	(15)	(16)	(17)	(18)
	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.		
Total ..																	
Cost per acre ..																	

	RS. A. P.
Total cost during the year 193	..
Average cost per acre	..
Total cost at the end of the year (including previous expenditure)	..
Average total cost per acre	..

Nursery Ledger.

Clear-felling (Experimental) Working Circle and Timber Working Circle.

Year—
Number of beds Size.
Whether new or old nursery.
Estimated number of seedlings/stumps required.
Actual number of seedlings/stumps produced.

Number of oeds sown.
Quantity of seeds used.
Method of sowing.
Method of raising stumps.
Number of transplant beds.
Espacement of transplanting.
Remarks on stocking.

Year and month.	Clearing and burning.	Uprooting stumps.	Fencing.	Formation of beds.		Cost of seed including treatment.	Sowing.	Watering.	Tending and soil-working.	Trans-planting in nursery.	Preparation of stumps.	Number of stumps prepared.	Other items of expenditure.	Remarks
				Original.	Re-forming.									
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
1932.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.	RS. A. P.		RS. A. P.	
May														
June														
July														
August														
September ..														
October														
November ..														
December ..														
1933.														
January ..														
February ..														
Total ..														

Grand total Rs.
Total cost per 1,000 stumps Rs.

Disposal of plants and cost.

Species.	Where used.	Number.		Cost.
		Stumps.	Seedlings.	RS. A. P.

Control Book.

The Fuel Working Circle.

The Nerankemale Felling Series.

Prescriptions of the working plan.					Result of operations.								
Year.	Locality to be exploited.			Nature of work.	Year.	Locality exploited.				Work done.	Yield.	Selling price.	Remarks.
	Reserve.	Coupe No.	Area in acres.			Reserve.	Coupe No.	Area in acres. Surveyed.	Area in acres. Felled.				
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
1932–33 ..	Nerankimale.	I	26	Simple coppice ..	1932–33.	Nerankimale ..	I	25	24	Simple coppice ..	Contractor's figures— Timber. C.FT. Xylia .. .. 50 Terminalia tomentosa .. 100 Chowks. Fuel .. .. 280 cartloads. Brushwood .. 11	RS. 32 per acre. Total Rs. 800.	

Record of Works.

The Fuel Working Circle.

The Nerankimale Felling Series.

Prescriptions of the working plan.					Operations carried out.						
Year.	Locality.			Nature of work.	Year.	Locality			Nature of work carried out.	Cost.	Remarks.
	Reserve.	Coupe No.	Area in acres.			Reserve.	Coupe No.	Area in acres.			
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
										RS. A. P.	
					A. Measures prescribed.						
1933–34 ..	Nerankimale ..	I	26	Climber-cutting	1933–34 ..	Nerankimale ..	I	16	Climber-cutting	8 0 0	10 acres regenerated under the Clear-felling (Experimental) Working Circle.
33–34 ..	Do. ..	I	26	Regeneration in blanks ..	1933–34 ..	Do. ..	I	16	Regeneration— Hopea Wightiana, Terminalia tomentosa 14 acres.	24 0 0	Do
1933–34 ..	Do. ..	I	26	Cleaning	1933–34 ..	Do. ..	I	16	Cleaning and weeding ..	32 0 0	Do.
					B. Measures suggested.						

C Measures neither prescribed nor suggested but carried out.

Control Book.

The Sandal Working Circle.

KASARAGOD RANGE.

Prescriptions of the working plan.				Operations carried out.					
	Locality.				Locality.			Outturn.	
Year.	Coupe No.	Names of villages to be worked.	Nature of fellings.	Year.	Coupe No.	Names of villages worked.	Nature of fellings.	Number of trees marked in each village.	Outturn of heart-wood.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
									QRS. LB.
				The Kasaragod Felling Series.					
1932–33 ..	I	Nidpalli ..	Selection fellings of trees over 15 inches in girth at breast-height and all dead trees.	1932–33 ..	I	Nidpalli ..	Selection fellings of trees over 15 inches in girth at breast-height and all dead trees.	280	90 10

Record of Works.

The Sandal Working Circle.

KASARAGOD RANGE.

Prescriptions of the working plan.			Operations carried out.			
Year.	Reserve.	Nature of work.	Year.	Reserve.	Nature of work.	Cost.
(1)	(2)	(3)	(4)	(5)	(6)	(7)
						RS. A. P.
		A. Measures prescribed.				
1935–36 ..	Adur ..	Establishment of ten propagation centres 12′ × 12′.	1935–36 ..	Adur ..	Established ten propagation centres 12′ × 12′.	..
		B. Measures suggested.				
1935–36 ..	Adur ..	Shading of sandal plants of 1932–33 by means of wicker-work baskets.	1935–36 ..	Adur ..	Shaded 50 plants with baskets	2 0 0
		C. Measures neither prescribed nor suggested but carried out.				
–	–	....	1935–36 ..	Adur ..	The plots of 1932–33 were thinned by the District Forest Officer.	..

The Hopea Improvement Working Circle.

UPPINANGADY RANGE.

Prescriptions of the working plan.					Operations actually carried out.						
Year.	Locality.	Coupe No.	Area in acres.	Nature of operations.	Year.	Locality.	Coupe No.	Area in acres.	Nature of operations.	Cost.	Remarks.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
										RS. A. P.	
				A. Measures prescribed.							
1933–34.	Devachalla Reserved Forest, Compartment 3.	I	102	Weeding, climber-cutting, cleaning, shade removal, etc.	1933–34.	Devachalla Reserved Forest, Compartment 3.	I	100	Weeding .. Climber-cutting .. Cleaning .. Shade-removal ..	30 0 0 13 0 0 30 0 0 150 0 0	Area of coupe after actual survey is 100 acres.
				B. Measures suggested.							
				C. Measures neither prescribed nor suggested but carried out.							

Register of Broadcast Sown Plots.

Hopea Improvement Working Circle.

Puttur Range—
Name of block :
Compartment No. Locality :
Year of sowing :
Extent in acres—
(*a*) Original :
(*b*) Maintained :

RS. A. P.

Cost of formation (including seed-collection, cutting of undergrowth, demarcation, etc.) .. ..

Cost of tending—

Year. RS. A. P.

1934–35 .. ..
1936–37 .. ..
1940–41 .. ..

Cost of shade-removal—
Year.

Total cost of establishing the plot .. ..

Remarks :—

Record of Works.

Minor Produce Working Circle.

Year.	Kinds and quantities of minor forest produce collected.	Total revenue for South Mangalore Division.	Remarks.
			RS. A. P.
Year.			
1931–32	Honey	124 tins.	10,350 0 0
	Wax	148 lb.	
	Canes	240 cart-loads.	
	Gall nuts	26 maunds.	
	Cinamon bark	120 lb.	
	Cardamoms on lease for 30 years at Rs. 1,500 per annum.		45,000 0 0
	Cinamon bark collected departmentally for experimental purposes		..
		Total ..	

Miscellaneous.

Record of Works.

Prescriptions of working plan.			Works carried out.					
Year.	Nature of work.	Details of work.	Year.	Nature of work.	Brief details of work.	Cost of each item.	Total cost of each work.	Remarks.
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
						RS. A. P.	RS. A. P.	

APPENDIX III.

Maps accompanying the working plan.

The maps enumerated below have been drawn to accompany the Working Plan. One complete set of each category is filed with other records in the office of the Conservator, III (Working Plans) Circle. The following officers will also be supplied :—

The Chief Conservator of Forests, Madras .. .. 1 set.
The Conservator of Forests, VI Circle, Ootacamund .. .. .. 1 set.
The District Forest Officer, South Mangalore .. .. 1 set.

Each officer in charge of the Kasaragod, Puttur and Uppinangady Ranges will be supplied with a copy of the Management Map (scale 1 inch to 1 mile) pertaining to his range.

List of Maps.

1. Key-map of South Kanara district to accompany the Working Plans for North and South Mangalore Divisions.

2. The Management Maps (scale 1 inch to 1 mile) for Kasaragod, Puttur and Uppinangady Ranges, respectively.

3. Stockmaps, on Survey of India sheet Nos. $48\frac{0}{8}$S, $48\frac{P}{1}$ S, $48\frac{P}{2}$ N, $48\frac{P}{2}$ S, $48\frac{P}{3}$ N, $48\frac{P}{5}$ N, $48\frac{P}{5}$ S, $48\frac{P}{6}$ N, $48\frac{P}{6}$ S, $48\frac{P}{7}$ N, $48\frac{P}{9}$ N, $48\frac{P}{9}$S, $48\frac{P}{10}$ N, $48\frac{P}{10}$ S, $48\frac{P}{11}$N.
(Scale 2 inches to 1 mile), showing vegetational types and plantations.

4. Detail maps (scale 4 inches to 1 mile) showing allocation of coupes and other details for the following Working Circles :—

The Timber Working Circle.
The Plantation Working Circle.
The Fuel Working Circle.
The Clear-felling (Experimental) Working Circle.
The Sandal Working Circle.
The Hopea Improvement Working Circle (for Kidu reserved forest only).

There are ten detail maps in all, to cover the Working Plan period.

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Proceedings of the Chief Conservator of Forests

Proceedings No. 484, Press, 31st October 1933

Working Plan—South Mangalore Division—Sanctioned.

A. WIMBUSH, Esq., I.F.S.,
Chief Conservator of Forests.

READ—the following paper :—

From the Conservator, Working Plans Circle, No. 867/27, dated 21st March 1933, forwarding the Working Plan for the forests of the South Mangalore Division.

Proceedings—No. 484, Press, dated 31st October 1933.

Sanctioned.

A. WIMBUSH,
Chief Conservator of Forests.

To the Conservator of Forests, Working Plans Circle.
,, Conservator, Ootacamund Circle.
,, District Forest Officer, South Mangalore.

Copy to the other Conservators and District Forest Officers.
,, Principal, Madras Forest College, Coimbatore.
,, Provincial Sylviculturist.
,, Working Plans Officers.
,, President, Forest Research Institute, Dehra Dun.